

## **Exhibit 26**

**United States Patent** [19][11] **Patent Number:** **4,922,432****Kobayashi et al.**[45] **Date of Patent:** **May 1, 1990**

- [54] **KNOWLEDGE BASED METHOD AND APPARATUS FOR DESIGNING INTEGRATED CIRCUITS USING FUNCTIONAL SPECIFICATIONS**
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- [22] Filed: Jan. 13, 1988
- [51] Int. Cl.<sup>3</sup> ..... G06F 15/60
- [52] U.S. Cl. .... 364/490; 364/489; 364/488; 364/521
- [58] Field of Search ..... 364/488-491, 364/521, 300, 513

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Primary Examiner—Felix D. Gruber

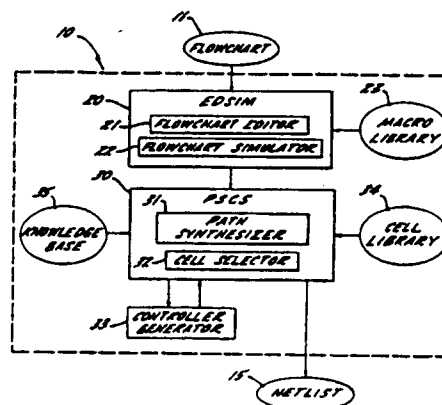
Assistant Examiner—V. N. Trans

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[57]

**ABSTRACT**

The present invention provides a computer-aided design system and method for designing an application specific integrated circuit which enables a user to define functional architecture independent specifications for the integrated circuit and which translates the functional architecture independent specifications into the detailed information needed for directly producing the integrated circuit. The functional architecture independent specifications of the desired integrated circuit can be defined at the functional architecture independent level in a flowchart format. From the flowchart, the system and method uses artificial intelligence and expert systems technology to generate a system controller, to select the necessary integrated circuit hardware cells needed to achieve the functional specifications, and to generate data and control paths for operation of the integrated circuit. This list of hardware cells and their interconnection requirements is set forth in a netlist. From the netlist it is possible using known manual techniques or existing VLSI CAD layout systems to generate the detailed chip level topological information (mask data) required to produce the particular application specific integrated circuit.

**20 Claims, 12 Drawing Sheets**

RCL000266



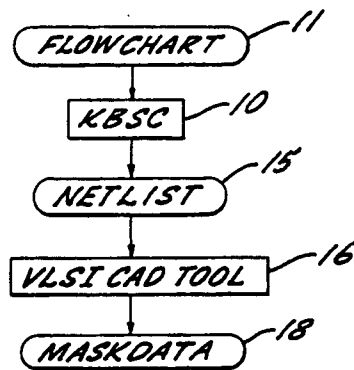


FIG. 2.

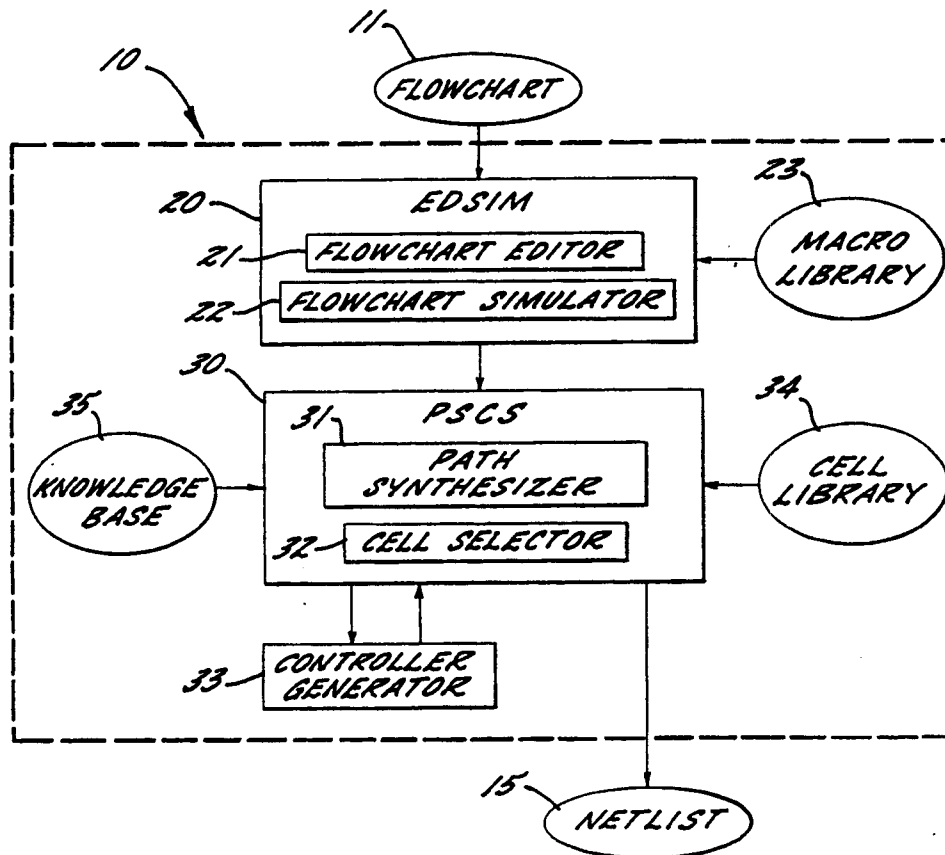
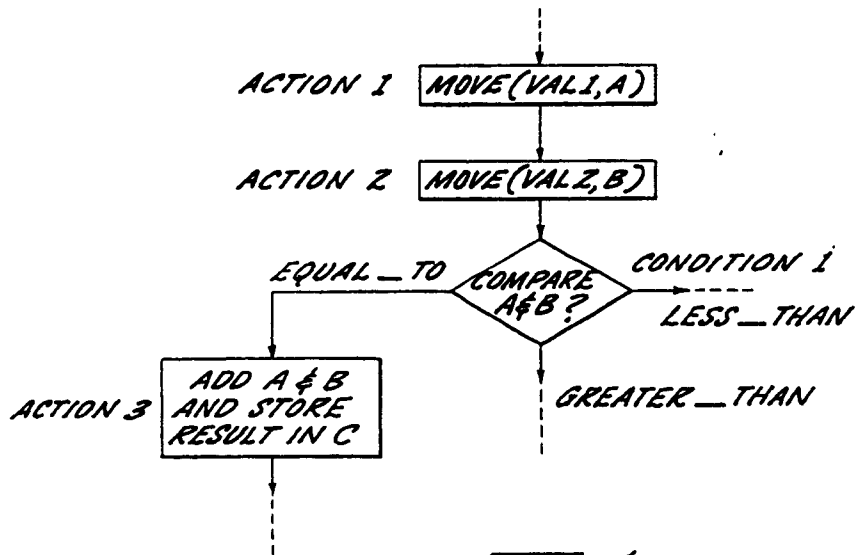
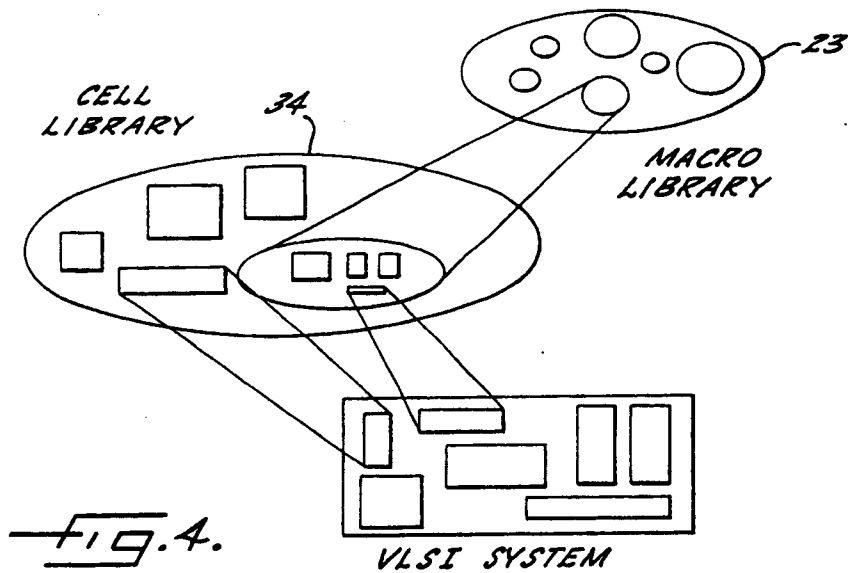


FIG. 3.



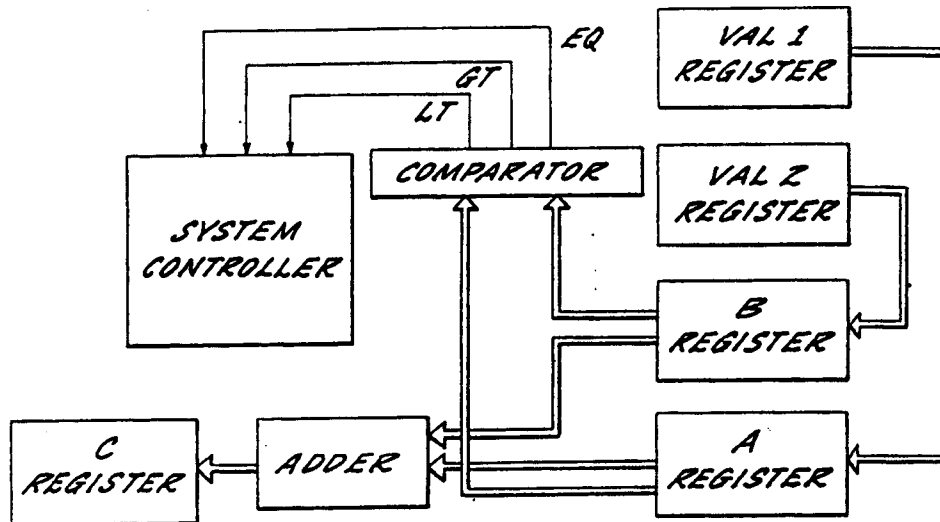


FIG. 6.

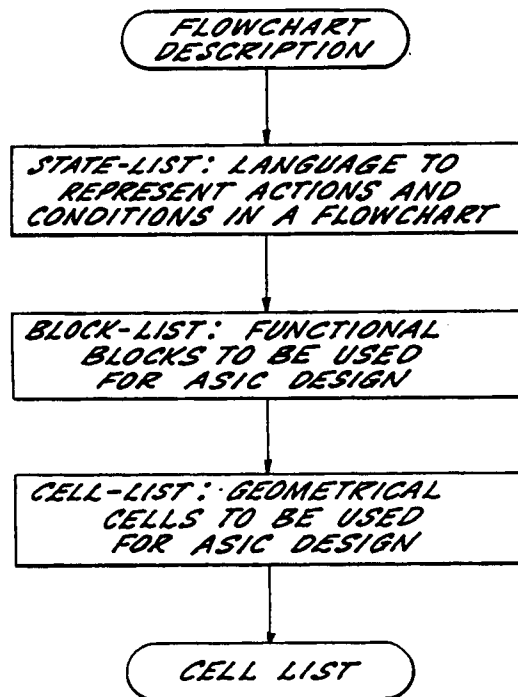


FIG. 9.

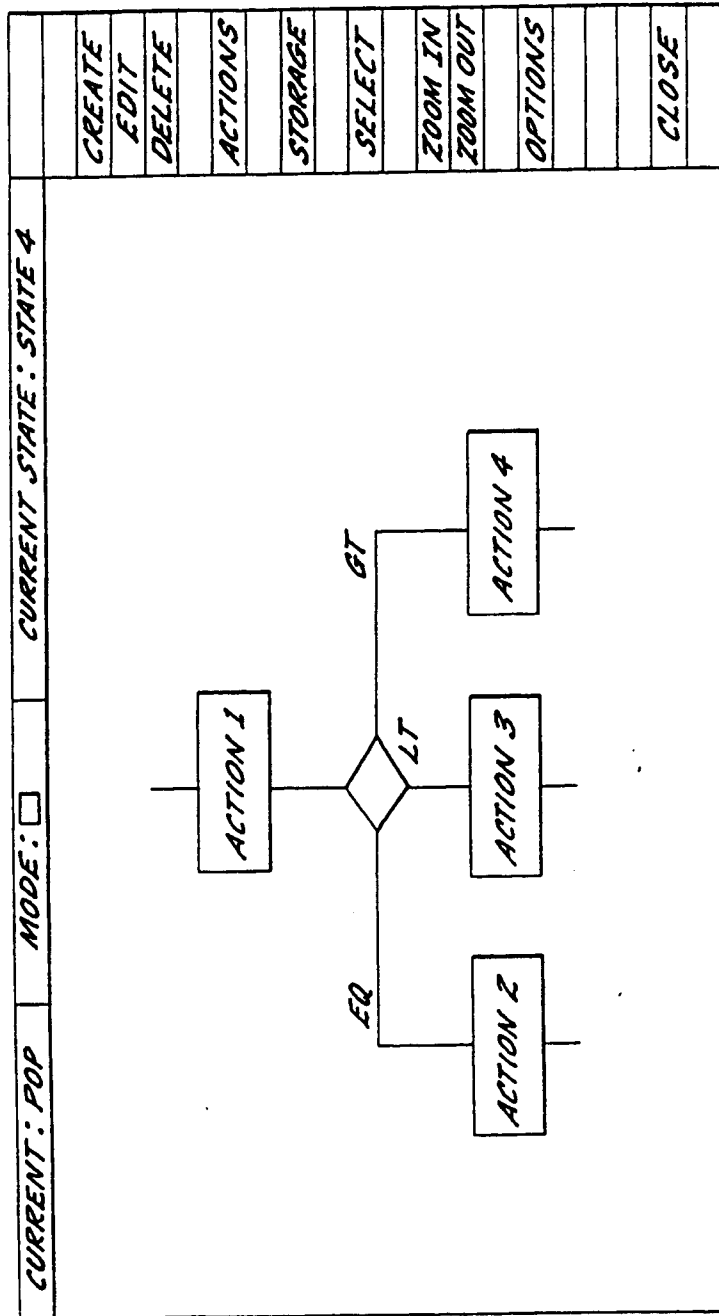


FIG. 7.

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EDIT DATA	SET BREAKS	STEP	HISTORY ON	CANCEL
SHOW DATA	CLEAR BREAKS	EXECUTE	DETAIL	HELP
SET STATE	SHOW BREAKS	STOP		CLOSE
<p>*** READY ***</p>				

FIG. 8.

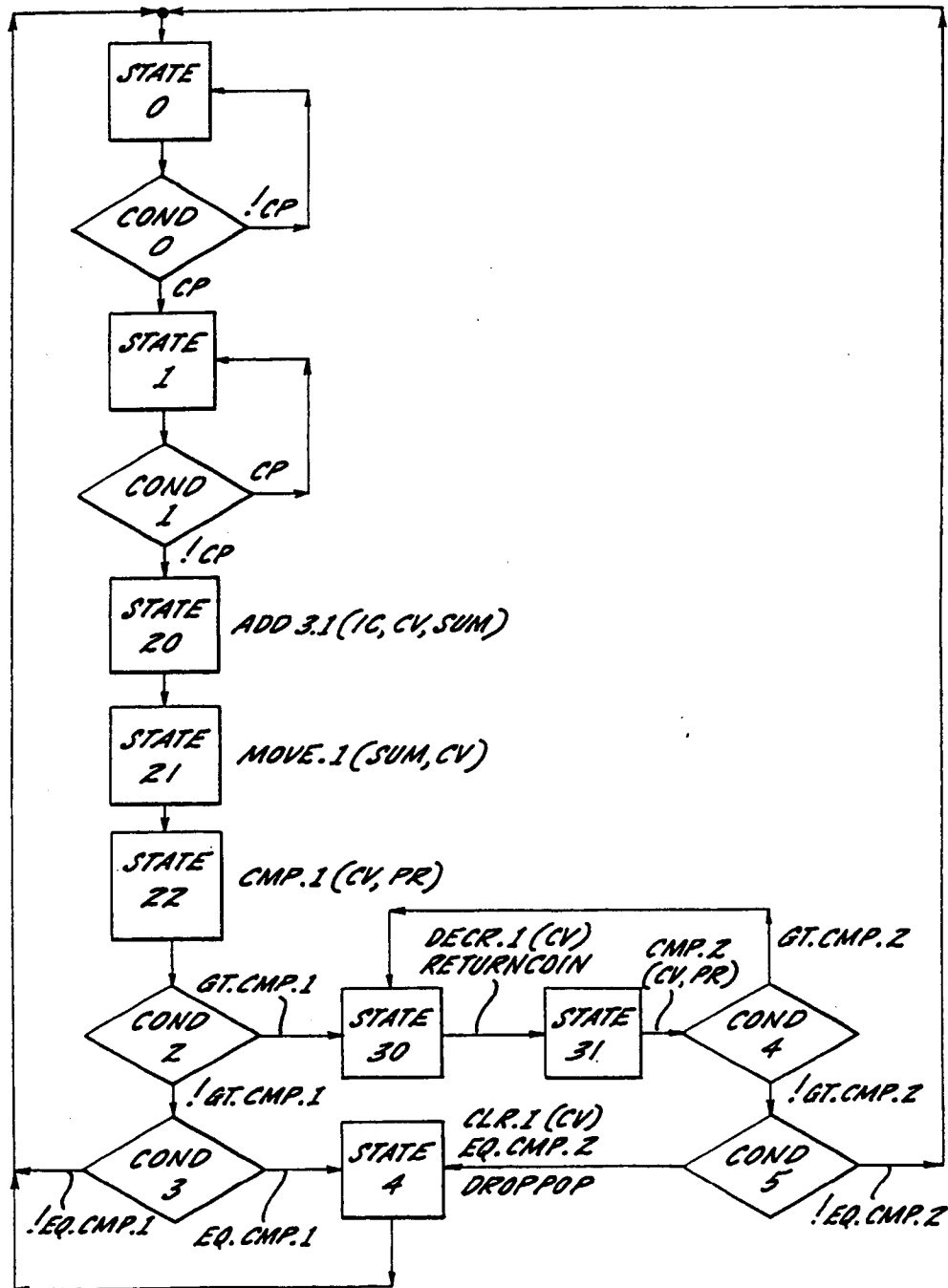


FIG. 10.

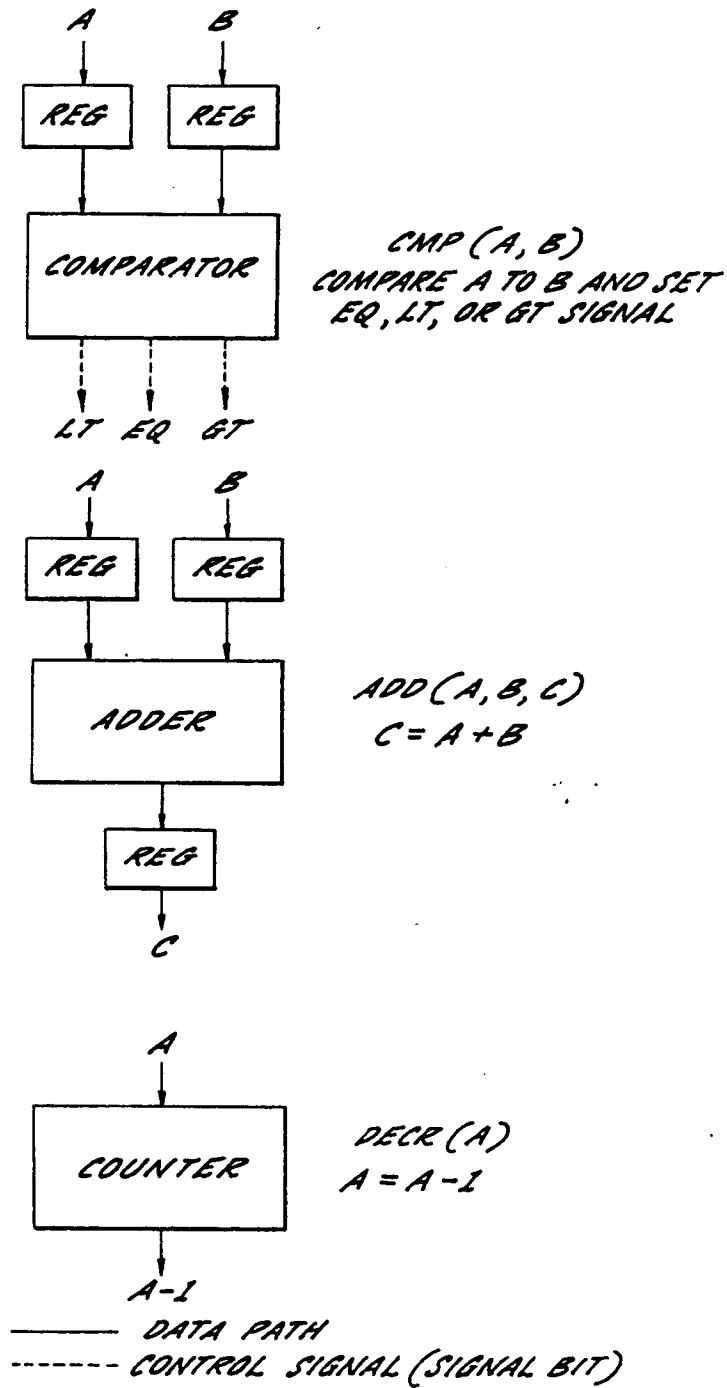
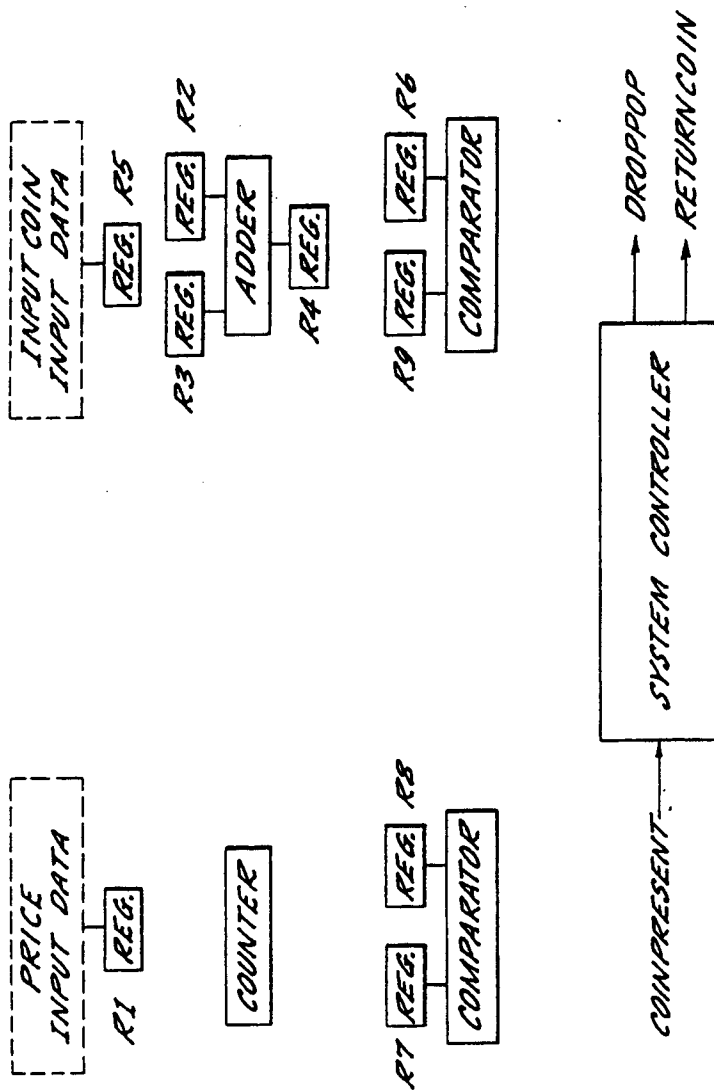


Fig. 11.

FIG. 12.

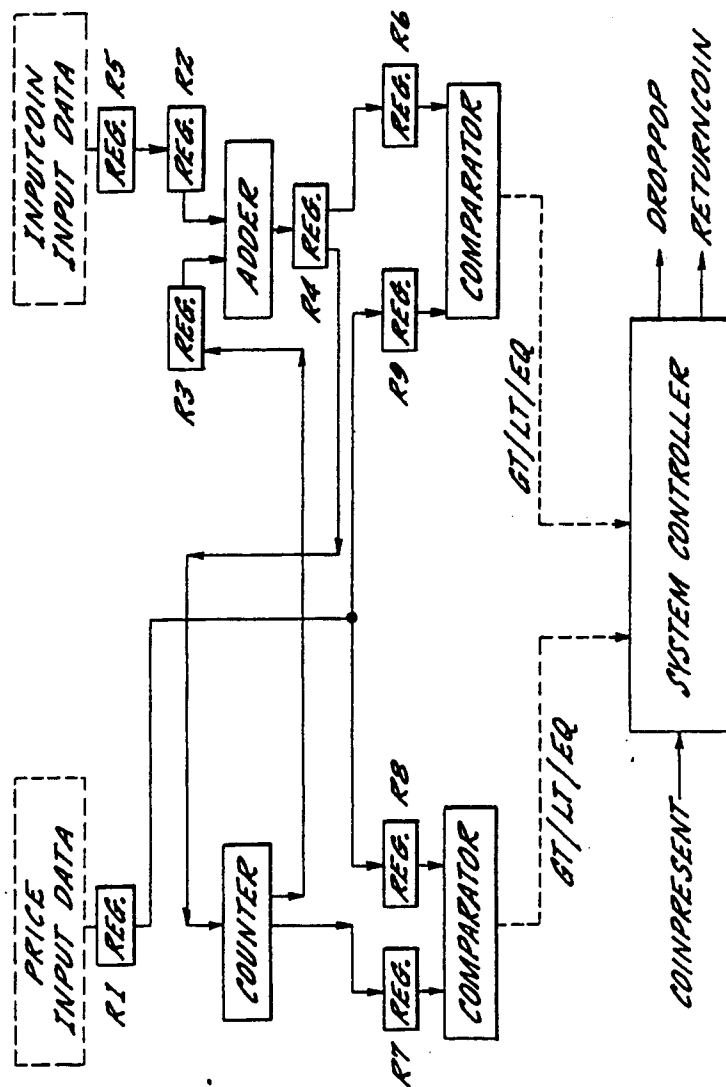


FIG. 13.

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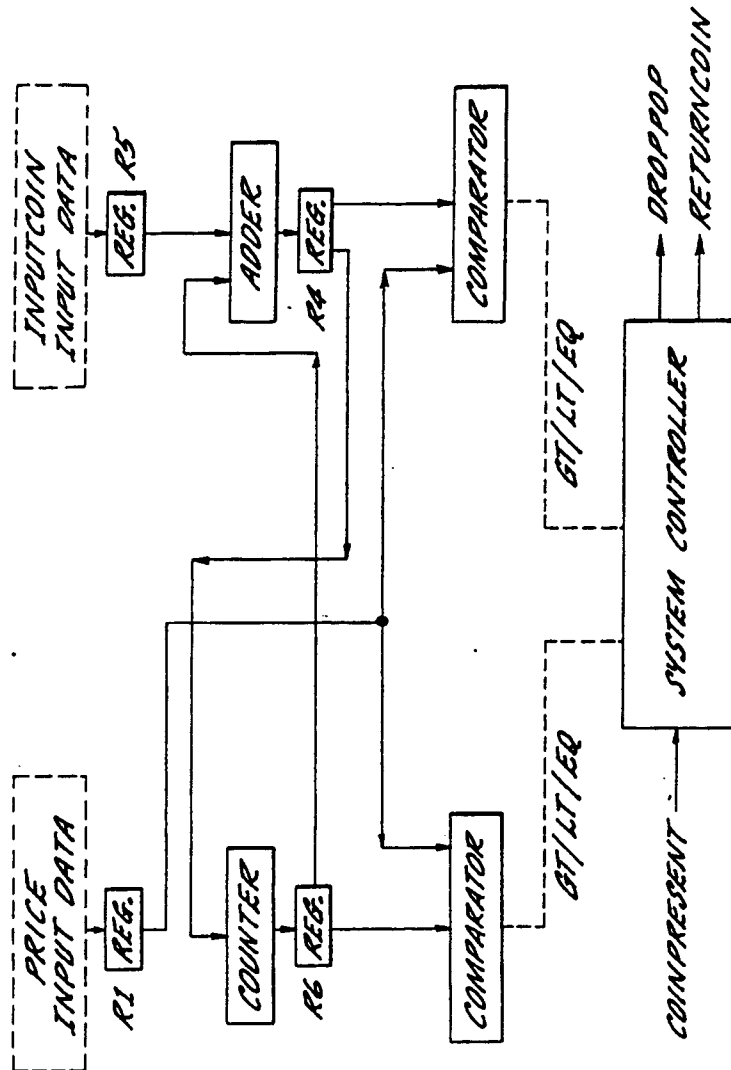


FIG. 14.

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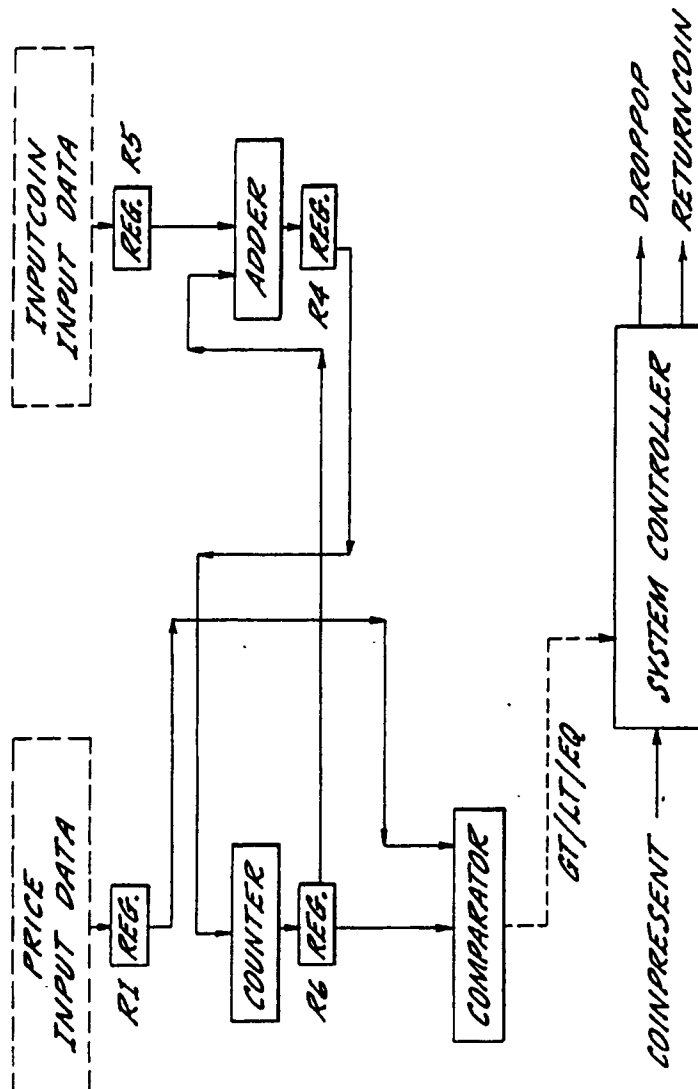


FIG. 15.

# KNOWLEDGE BASED METHOD AND APPARATUS FOR DESIGNING INTEGRATED CIRCUITS USING FUNCTIONAL SPECIFICATIONS

## FIELD AND BACKGROUND OF THE INVENTION

This invention relates to the design of integrated circuits, and more particularly relates to a computer-aided method and apparatus for designing integrated circuits.

An application specific integrated circuit (ASIC) is an integrated circuit chip designed to perform a specific function, as distinguished from standard, general purpose integrated circuit chips, such as microprocessors, memory chips, etc. A highly skilled design engineer having specialized knowledge in VLSI circuit design is ordinarily required to design a ASIC. In the design process, the VLSI design engineer will consider the particular objectives to be accomplished and tasks to be performed by the integrated circuit and will create structural level design specifications which define the various hardware components required to perform the desired function, as well as the interconnection requirements between these components. A system controller must also be designed for synchronizing the operations of these components. This requires an extensive and all encompassing knowledge of the various hardware components required to achieve the desired objectives, as well as their interconnection requirements, signal level compatibility, timing compatibility, physical layout, etc. At each design step, the designer must do tedious analysis. The design specifications created by the VLSI design engineer may, for example, be in the form of circuit schematics, parameters or specialized hardware description languages (HDLs).

From the structural level design specifications, the description of the hardware components and interconnections is converted to a physical chip layout level description which describes the actual topological characteristics of the integrated circuit chip. This physical chip layout level description provides the mask data needed for fabricating the chip.

Due to the tremendous advances in very large scale integration (VLSI) technology, highly complex circuit systems are being built on a single chip. With their complexity and the demand to design custom chips at a faster rate, in large quantities, and for an ever increasing number of specific applications, computer-aided design (CAD) techniques need to be used. CAD techniques have been used with success in design and verification of integrated circuits, at both the structural level and at the physical layout level. For example, CAD systems have been developed for assisting in converting VLSI structural level descriptions of integrated circuits into the physical layout level topological mask data required for actually producing the chip. Although the presently available computer-aided design systems greatly facilitate the design process, the current practice still requires highly skilled VLSI design engineers to create the necessary structural level hardware descriptions.

There is only a small number of VLSI designers who possess the highly specialized skills needed to create structural level integrated circuit hardware descriptions. Even with the assistance of available VLSI CAD tools, the design process is time consuming and the probability of error is also high because of human in-

volvements. There is a very significant need for a better and more cost effective way to design custom integrated circuits.

## SUMMARY OF THE INVENTION

In accordance with the present invention a CAD (computer-aided design) system and method is provided which enables a user to define the functional requirements for a desired target integrated circuit, using an easily understood functional architecture independent level representation, and which generates therefrom the detailed information needed for directly producing an application specific integrated circuit (ASIC) to carry out those specific functions. Thus, the present invention, for the first time, opens the possibility for the design and production of ASICs by designers, engineers and technicians who may not possess the specialized expert knowledge of a highly skilled VLSI design engineer.

The functional architecture independent specifications of the desired ASIC can be defined in a suitable manner, such as in list form or preferably in a flowchart format. The flowchart is a highly effective means of describing a sequence of logical operations, and is well understood by software and hardware designers of varying levels of expertise and training. From the flowchart (or other functional specifications), the system and method of the present invention translates the functional architecture independent specifications into structural an architecture specific level definition of an integrated circuit, which can be used directly to produce the ASIC. The structural level definition includes a list of the integrated circuit hardware cells needed to achieve the functional specifications. These cells are selected from a cell library of previously designed hardware cells of various functions and technical specifications. The system also generates data paths among the selected hardware cells. In addition, the present invention generates a system controller and control paths for the selected integrated circuit hardware cells. The list of hardware cells and their interconnection requirements may be represented in the form of a netlist. From the netlist it is possible using either known manual techniques or existing VLSI CAD layout systems to generate the detailed chip level geometrical information (e.g. mask data) required to produce the particular application specific integrated circuit in chip form.

The preferred embodiment of the system and method of the present invention which is described more fully hereinafter is referred to as a Knowledge Based Silicon Compiler (KBSC). The KBSC is an ASIC design methodology based upon artificial intelligence and expert systems technology. The user interface of KBSC is a flowchart editor which allows the designer to represent VLSI systems in the form of a flowchart. The KBSC utilizes a knowledge based expert system, with a knowledge base extracted from expert ASIC designers with a high level of expertise in VLSI design to generate from the flowchart a netlist which describes the selected hardware cells and their interconnection requirements.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood by reference to the detailed description which follows, taken in connection with the accompanying drawings, in which

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FIG. 1a illustrates a functional level design representation of a portion of a desired target circuit, shown in the form of a flowchart;

FIG. 1b illustrates a structural level design representation of an integrated circuit;

FIG. 1c illustrates a design representation of a circuit at a physical layout level, such as would be utilized in the fabrication of an integrated circuit chip;

FIG. 2 is a block schematic diagram showing how integrated circuit mask data is created from flowchart descriptions by the KBSC system of the present invention;

FIG. 3 is a somewhat more detailed schematic illustration showing the primary components of the KBSC system;

FIG. 4 is a schematic illustration showing how the ASIC design system of the present invention draws upon selected predefined integrated circuit hardware cells from a cell library;

FIG. 5 is an example flowchart defining a sequence of functional operations to be performed by an integrated circuit;

FIG. 6 is a structural representation showing the hardware blocks and interconnection requirements for the integrated circuit defined in FIG. 5;

FIG. 7 is an illustration of the flowchart editor window;

FIG. 8 is an illustration of the flowchart simulator window;

FIG. 9 is an illustration of the steps involved in cell list generation;

FIG. 10 is an example flowchart for a vending machine system;

FIG. 11 illustrates the hardware components which correspond to each of the three macros used in the flowchart of FIG. 10;

FIG. 12 is an initial block diagram showing the hardware components for an integrated circuit as defined in the flowchart of FIG. 10;

FIG. 13 is a block diagram corresponding to FIG. 12 showing the interconnections between blocks;

FIG. 14 is a block diagram corresponding to FIG. 13 after register optimization; and

FIG. 15 is a block diagram corresponding to FIG. 14 after further optimization.

#### DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

FIGS. 1a, 1b and 1c illustrate three different levels of representing the design of an integrated circuit. FIG. 1a shows a functional (or behavioral) representation architecture independent in the form of a flowchart. A flowchart is a graphic representation of an algorithm and consists of two kinds of blocks or states, namely actions and conditions (decisions). Actions are conventionally represented in the flowchart by a rectangle or box, and conditions are represented by a diamond. Transitions between actions and conditions are represented by lines with arrows. FIG. 1b illustrates a structural (or logic) level representation of an integrated circuit. In this representation, blocks are used to represent integrated architecture specific circuit hardware components for performing various functions, and the lines interconnecting the blocks represent paths for the flow of data or control signals between the blocks. The blocks may, for example, represent hardware components such as adders, comparators, registers, system controllers, etc. FIG. 1c illustrates a physical layout level representation

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of an integrated circuit design, which provides the detailed mask data necessary to actually manufacture the devices and conductors which together comprise integrated circuit.

As noted earlier, the design of an integrated circuit at the structural level requires a design engineer with highly specialized skills and expertise in VLSI design. In the KBSC system of the present invention, however, integrated circuits can be designed at a functional level because the expertise in VLSI design is provided and applied by the invention. Allowing the designer to work with flowcharts instead of logic circuit schematics simplifies the task of designing custom integrated circuits, making it quicker, less expensive and more reliable. The designer deals with an algorithm using simple flowcharts at an architecture independent functional (behavioral) level, and needs to know only the necessary logical steps to complete a task, rather than the specific means for accomplishing the task. Designing with flowcharts requires less work in testing because flowcharts allow the designer to work much closer to the algorithm. On the other hand, previously existing VLSI design tools require the designer to represent an algorithm with complex circuit schematics at a structural level, therefore requiring more work in testing. Circuit schematics make it harder for the designer to cope with the algorithm function which needs to be incorporated into the target design because they intermix the hardware and functional considerations. Using flowcharts to design custom integrated circuits will allow a large number of system designers to access VLSI technology, where previously only a small number of designers had the knowledge and skills to create the necessary structural level hardware descriptions.

The overall system flow is illustrated in FIG. 2. The user enters the functional specifications of the circuit into the knowledge based silicon compiler (KBSC) 10 in the form of a flowchart 11. The KBSC 10 then generates a netlist 15 from the flowchart. The netlist 15 includes a custom generated system controller, all other hardware cells required to implement the necessary operations, and interconnection information for connecting the hardware cells and the system controller. The netlist can be used as input to any existing VLSI layout and routing tool 16 to create mask data 18 for geometrical layout.

#### System Overview

The primary elements or modules which comprise the KBSC system are shown in FIG. 3. In the embodiment illustrated and described herein, these elements or modules are in the form of software programs, although persons skilled in the appropriate art will recognize that these elements can easily be embodied in other forms, such as in hardware.

Referring more particularly to FIG. 3, it will be seen that the KBSC system 10 includes a program 20 called EDSIM, which comprises a flowchart editor 21 for creating and editing flowcharts and a flowchart simulator 22 for simulation and verification of flowcharts. Actions to be performed by each of the rectangles represented in the flowchart are selected from a macro library 23. A program 30 called PSCS (path synthesizer and cell selector) includes a data and control path synthesizer module 31, which is a knowledge based system for data and control path synthesis. PSCS also includes a cell selector 32 for selecting the cells required for system design. The cell selector 32 selects from a cell

library 34 of previously designed hardware cells the appropriate cell or cells required to perform each action and condition represented in the flowchart. A controller generator 33 generates a custom designed system controller for controlling the operations of the other hardware cells. The knowledge base 35 contains ASIC design expert knowledge required for data path synthesis and cell selection. Thus, with a functional flowchart input, PSCS generates a system controller, selects all other hardware cells, generates data and control paths, and generates a netlist describing all of this design information.

The KBSC system employs a hierarchal cell selection ASIC design approach, as is illustrated in FIG. 4. Rather than generating every required hardware cell from scratch, the system draws upon a cell library 34 of previously designed, tested and proven hardware cells of various types and of various functional capabilities with a given type. The macro library 23 contains a set of macros defining various actions which can be specified in the flowchart. For each macro function in the macro library 23 there may be several hardware cells in the cell library 34 of differing geometry and characteristics capable of performing the specified function. Using a rule based expert system with a knowledge base 35 extracted from expert ASIC designers, the KBSC system selects from the cell library 34 the optimum cell for carrying out the desired function.

Referring again to FIG. 3, the cells selected by the cell selector 32, the controller information generated by the controller generator 33 and the data and control paths generated by the data/control path synthesizer 31 are all utilized by the PSCS program 30 to generate the netlist 15. The netlist is a list which identifies each block in the circuit and the interconnections between the respective inputs and outputs of each block. The netlist provides all the necessary information required to produce the integrated circuit. Computer-aided design systems for cell placement and routing are commercially available which will receive netlist data as input and will lay out the respective cells in the chip, generate the necessary routing, and produce mask data which can be directly used by a chip foundry in the fabrication of integrated circuits.

#### System Requirements

The KBSC system can be operated on a suitable programmed general purpose digital computer. By way of example, one embodiment of the system is operated in a work station environment such as Sun3 and VAXStation-II/GPX Running UNIX Operating System and X Window Manager. The work station requires a minimum of 8 megabytes of main storage and 20 megabytes of hard disk space. The monitor used is a color screen with 8-bit planes. The software uses C programming language and INGRES relational data base.

The human interface is mainly done by the use of pop up menus, buttons, and a special purpose command language. The permanent data of the integrated circuit design are stored in the data base for easy retrieval and update. Main memory stores the next data temporarily, executable code, design data (flowchart, logic, etc.), data base (cell library), and knowledge base. The CPU performs the main tasks of creating and simulating flowcharts and the automatic synthesis of the design.

#### Flowchart Example

To describe the mapping of a flowchart to a netlist, consider an example flowchart shown in FIG. 5, which is of part of a larger overall system. In this illustrative flowchart, two variables, VAL1 and VAL2 are compared and if they are equal, they are added together. In this instance, the first action (Action 1) involves moving the value of variable VAL1 to register A. The second action comprises moving the value of variable VAL2 to register B. Condition 1 comprises comparing the values in registers A and B. Action 3 comprises adding the values of registers A and B and storing the result in register C.

In producing an integrated circuit to carry out the function defined in FIG. 5, the KBSC maps the flowchart description of the behavior of the system to interconnection requirements between hardware cells. The hardware cells are controlled by a system controller which generates all control signals. There are two types of variables involved in a system controller:

(1) Input variables: These are generated by hardware cells, and/or are external input to the controller. These correspond to conditions in the flowchart.

(2) Output variables: These are generated by the system controller and correspond to actions in the flowchart.

FIG. 6 illustrates the results of mapping the flowchart of FIG. 5 onto hardware cells. The actions and the conditions in the flowchart are used for cell selection and data and control path synthesis. The VAL1 register and VAL2 register and the data paths leading therefrom have already been allocated in actions occurring before Action 1 in our example. Action 1 causes generation of the data register A. Similarly, Action 2 causes the allocation of data register B. The comparator is allocated as a result of the comparison operation in Condition 1. The comparison operation is accomplished by (1) selecting a comparator cell, (2) mapping the inputs of the comparator cell to registers A and B, (3) generating data paths to connect the comparator with the registers A and B and (4) generating input variables corresponding to equal to, greater than, and less than for the system controller. Similarly the add operation in Action 3 causes selection of the adder cell, mapping of the adder parameters to the registers and creating the data paths.

Following this methodology, a block list can be generated for a given flowchart. This block list consists of a system controller and as many other blocks as may be required for performing the necessary operations. The blocks are connected with data paths, and the blocks are controlled by the system controller through control paths. These blocks can be mapped to the cells selected from a cell library to produce a cell list.

#### Interactive Flowchart Editor and Simulator

The creation and verification of the flowchart is the first step in the VLSI design methodology. The translation from an algorithm to an equivalent flowchart is performed with the Flowchart Editor 21 (FIG. 3). The verification of the edited flowchart is performed by the Flowchart Simulator 22. The Flowchart Editor and Simulator are integrated into one working environment for interactive flowchart editing, with a designer friendly interface.

EDSIM is the program which contains the Flowchart Editor 21 and the Flowchart Simulator 22. It also provides functions such as loading and saving flow-

charts. EDSIM will generate an intermediate file, called a statelist, for each flowchart. This file is then used by the PSCS program 30 to generate a netlist.

#### Flowchart Editor

The Flowchart Editor 21 is a software module used for displaying, creating, and editing the flowchart. This module is controlled through the flowchart editing window illustrated in FIG. 7. Along with editing functions the Flowchart Editor also provides checking of design errors.

The following is a description of the operations of the Flowchart Editor. The main editing functions include, create, edit, and delete states, conditions, and transitions. The create operation allows the designer to add a new state, condition, or transitions to a flowchart. Edit allows the designer to change the position of a state, condition or transition, and delete allows the designer to remove a state, condition or transition from the current flowchart. States which contain actions are represented by boxes, conditions are represented by diamonds, and transitions are represented by lines with arrows showing the direction of the transition.

Edit actions allows the designer to assign actions to each box. These actions are made up of macro names and arguments. An example of arguments is the setting and clearing of external signals. A list of basic macros available in the macro library 23 is shown in Table 1.

TABLE 1

Macro	Description
ADD (A,B,C)	$C = A + B$
SUB (A,B,C)	$C = A - B$
MULT (A,B,C)	$C = A * B$
DIV (A,B,C)	$C = A \text{ div } B$
DECR (A)	$A = A - 1$
INCR (A)	$A = A + 1$
CLR (A)	$A = 0$
REG (A,B)	$B = A$
CMP (A,B)	Compare A to B and set EQ,LT,GT signals
CMP0 (A)	Compare A to 0 and set EQ,LT,GT signals
NEGATE (A)	$A = \text{NOT } (A)$
MOD (A,B,C)	$C = A \text{ Modulus } B$
POW (A,B,C)	$C = A^B$
DC2 (A,S1,S2,S3,S4)	Decode A into S1,S2,S3,S4
EC2 (S1,S2,S3,S4,A)	Encode S1,S2,S3,S4 into A
MOVE (A,B)	$B = A$
CALL sub-flowchart (A,B,...)	Call a sub-flowchart. Pass A,B...
START (A,B,...)	Beginning state of a sub-flowchart
STOP (A,B,...)	Ending state of a sub-flowchart

The Flowchart Editor also provides a graphical display of the flowchart as the Flowchart Simulator simulates the flowchart. This graphical display consists of boxes, diamonds, and lines as shown in FIG. 7. All are drawn on the screen and look like a traditional flowchart. By displaying the flowchart on the screen during simulation it allows the designer to design and verify the flowchart at the same time.

#### Flowchart Simulator

The Flowchart Simulator 22 is a software module used for simulating flowcharts. This module is controlled through the simulator window illustrated in FIG. 8. The Flowchart Simulator simulates the transitions between states and conditions in a flowchart. The following is a list of the operations of the Flowchart Simulator:

edit data—Change the value of a register or memory.

set state—Set the next state to be simulated.  
 set detail or summary display—Display summary or detail information during simulation.  
 set breaks—Set a breakpoint.  
 clear breaks—Clear all breakpoints.  
 show breaks—Display current breakpoints.  
 step—Step through one transition.  
 execute—Execute the flowchart.  
 stop—Stop executing of the flowchart. history ON or history OFF—Set history recording on or off.  
 cancel—Cancel current operation.  
 help—Display help screen.  
 close—Close the simulator window.

The results of the simulation are displayed within the simulator window. Also the editor window will track the flowchart as it is being simulated. This tracking of the flowchart makes it easy to edit the flowchart when an error is found.

#### Cell Selection

The Cell Selector 32 is a knowledge based system for selecting a set of optimum cells from the cell library 34 to implement a VLSI system. The selection is based on functional descriptions in the flowchart, as specified by the macros assigned to each action represented in the flowchart. The cells selected for implementing a VLSI system depend on factors such as cell function, fabrication technology used, power limitations, time delays etc. The cell selector uses a knowledge base extracted from VLSI design experts to make the cell selection.

To design a VLSI system from a flowchart description of a user application, it is necessary to match the functions in a flowchart with cells from a cell library. This mapping needs the use of artificial intelligence techniques because the cell selection process is complicated and is done on the basis of a number of design parameters and constraints. The concept used for cell selection is analogous to that used in software compilation. In software compilation a number of subroutines are linked from libraries. In the design of VLSI systems, a functional macro can be mapped to library cell.

FIG. 4 illustrates the concept of hierarchical cell selection. The cell selection process is performed in two steps:

- (1) selection of functional macros
- (2) selection of geometrical cells

A set of basic macros is shown in Table 1. A macro corresponds to an action in the flowchart. As an example, consider the operation of adding A and B and storing the result in C. This function is mapped to the addition macro ADD(X, Y, Z). The flowchart editor and flowchart simulator are used to draw the rectangles, diamonds and lines of the flowchart, to assign a macro selected from the macro library 23 to each action represented in the flowchart, and to verify the functions in flowcharts. The flowchart is converted into an intermediate form (statelist) and input to the Cell Selector.

The Cell Selector uses a rule based expert system to select the appropriate cell or cells to perform each action. If the cell library has a number of cells with different geometries for performing the operation specified by the macro, then an appropriate cell can be selected on the basis of factors such as cell function, process technology used, time delay, power consumption, etc.

The knowledge base of Cell Selector 32 contains information (rules) relating to:

- (1) selection of macros
- (2) merging two macros

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- (3) mapping of macros to cells
- (4) merging two cells
- (5) error diagnostics

The above information is stored in the knowledge base 35 as rules.

#### Cell List Generation

FIG. 9 shows the cell list generation steps. The first step of cell list generation is the transformation of the flowchart description into a structure that can be used by the Cell Selector. This structure is called the statelist. The blocklist is generated from the statelist by the inference engine. The blocklist contains a list of the functional blocks to be used in the integrated circuit. Rules of the following type are applied during this stage.

map arguments to data paths

map actions to macros

connect these blocks

Rules also provide for optimization and error diagnostics at this level.

The cell selector maps the blocks to cells selected from the cell library 34. It selects an optimum cell for a block. This involves the formulation of rules for selecting appropriate cells from the cell library. Four types of information are stored for each cell. These are:

- (1) functional level information: description of the cell at the register transfer level.
- (2) logic level information: description in terms of flip-flops and gates.
- (3) circuit level information: description at the transistor level.
- (4) Layout level information: geometrical mask level specification.

The attributes of a cell are:

cell name  
description  
function  
width  
height  
status  
technology  
minimum delay  
typical delay  
maximum delay  
power  
file  
designer  
date  
comment  
inspector

In the cell selection process, the above information can be used. Some parameters that can be used to map macros to cells are:

- (1) name of macro
- (2) function to be performed
- (3) complexity of the chip
- (4) fabrication technology
- (5) delay time allowed
- (6) power consumption
- (7) bit size of macro data paths

#### Netlist Generation

The netlist is generated after the cells have been selected by PSCS. PSCS also uses the macro definitions for connecting the cell terminals to other cells. PSCS uses the state-to-state transition information from an intermediate form representation of a flowchart (i.e. the

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statelist) to generate a netlist. PSCS contains the following knowledge for netlist generation:

- (1) Data path synthesis
- (2) Data path optimization
- (3) Macro definitions
- (4) Cell library
- (5) Error detection and correction

The above information is stored in the knowledge base 35 as rules. Knowledge engineers help in the formulation of these rules from ASIC design experts. The macro library 23 and the cell library 34 are stored in a database of KBSC.

A number of operations are performed by PSCS. The following is a top level description of PSCS operations:

- (1) Read the flowchart intermediate file and build a statelist.

- (2) current\_context = START

- (3) Start the inference engine and load the current context rules.

- (4) Perform one of the following operations depending upon current\_context:

- (a) Modify the statelist for correct implementation.

- (b) Create blocklist, macrolist and data paths.

- (c) Optimize blocklist and datapath list and perform error checks.

- (d) Convert blocks to cells.

- (e) Optimize cell list and perform error checks.

- (f) Generate netlist.

- (g) Optimize netlist and perform error checks and upon completion Goto 7.

- (5) If current\_context has changed, load new context rules.

- (6) Goto 4.

- (7) Output netlist file and stf files and Stop.

In the following sections, operations mentioned in step 4 are described. The Rule Language and PSCS display are also described.

#### Rule Language

The rule language of PSCS is designed to be declarative and to facilitate rule editing. In order to make the expert understand the structure of the knowledge base, the rule language provides means for knowledge representation. This will enable the format of data structures to be stated in the rule base, which will enable the expert to refer to them and understand the various structures used by the system. For example, the expert can analyze the structure of wire and determine its components. The expert can then refer these components into rules. If a new object has to be defined, then the expert can declare a new structure and modify some existing structure to link to this new structure. In this way, the growth of the data structures can be visualized better by the expert. This in turn helps the designer to update and append rules.

The following features are included in the rule language:

- (i) Knowledge representation in the form of a record structure.

- (ii) Conditional expressions in the antecedent of a rule.

- (iii) Facility to create and destroy structure in rule actions.

- (iv) The assignment statement in the action of a rule.

- (v) Facility for input and output in rule actions.

- (vi) Provide facility to invoke C functions from rule actions.

The rule format to be used is as follows:

The rule format to be used is as follows:		
Rule	<number>	<context>
IF {	<if-clause>	
}		
Then {	<then-clause>	
}		
where	<number>	rule number
	<context>	context in which this rule is active
	<if-clause>	the condition part of the rule
	<then-clause>	the action part of the rule

### Inference Strategy

The inference strategy is based on a fast pattern matching algorithm. The rules are stored in a network and the requirement to iterate through the rules is avoided. This speeds up the execution. The conflict resolution strategy to be used is based on the following:

(1) The rule containing the most recent data is selected.

(2) The rule which has the most complex condition is selected.

(3) The rule declared first is selected.

### Rule Editor

PSCS provides an interactive rule editor which enables the expert to update the rule set. The rules are stored in a database so that editing capabilities of the database package can be used for rule editing. To perform this operation the expert needs to be familiar with the various knowledge structures and the inferencing process. If this is not possible, then the help of a knowledge engineer is needed.

PSCS provides a menu from which various options can be set. Mechanisms are provided for setting various debugging flags and display options, and for the overall control of PSCS.

Facility is provided to save and display the blocklist created by the user. The blocklist configuration created by the user can be saved in a file and later be printed with a plotter. Also the PSCS display can be reset to restart the display process.

PSCS Example Rules:		
Rule 1	IF	no blocks exist
	THEN	generate a system controller.
Rule 2	IF	a state exists which has a macro AND this macro has not been mapped to a block
	THEN	find a corresponding macro in the library and generate a block for this macro.
Rule 3	IF	there is a transition between two states AND there are macros in these states using the same argument
	THEN	make a connection from a register corresponding to the first macro to another register corresponding to the second macro.
Rule 4	IF	a register has only a single connection from another register
	THEN	combine these registers into a single register.
Rule 5	IF	there are two comparators AND input data widths are of the same size AND

### -continued

PSCS Example Rules:		
		one input of these is same AND the outputs of the comparators are used to perform the same operation. combine these comparators into a single comparator.
5	THEN	
Rule 6	IF	there is a data without a register
	THEN	allocate a register for this data.
10	Rule 7	IF
	IF	all the blocks have been interconnected AND a block has a few terminals not connected
	THEN	remove the block and its terminals, or issue an error message.
15	Rule 8	IF
	IF	memory is to be used, but a block has not been created for it
	THEN	create a memory block with data, address, read and write data and control terminals.
20	Rule 9	IF
	IF	a register has a single connection to a counter
	THEN	combine the register and the counter; remove the register and its terminals.
25	Rule 10	IF
	IF	there are connections to a terminal of a block from many different blocks
	THEN	insert a multiplexor; remove the connections to the terminals and connect them to the input of the multiplexor; connect the output of the multiplexor to the input of the block.

Additional rules address the following points:  
remove cell(s) that can be replaced by using the outputs of other cell(s)

reduce multiplexor trees

use fan-out from the cells, etc.

### Soft Drink Vending Machine Controller Design Example

The following example illustrates how the previously described features of the present invention are employed in the design of an application specific integrated circuit (ASIC). In this illustrative example the ASIC is designed for use as a vending machine controller. The vending machine controller receives a signal each time a coin has been deposited in a coin receiver. The coin value is recorded and when coins totalling the correct amount are received, the controller generates a signal to dispense a soft drink. When coins totalling more than the cost of the soft drink are received, the controller dispenses change in the correct amount.

This vending machine controller example is patterned after a textbook example used in teaching digital system controller design. See Fletcher, William I., *An Engineering Approach to Digital Design*, Prentice-Hall, Inc., pp. 491-505. Reference may be made to this textbook example for a more complete explanation of this vending machine controller requirements, and for an understanding and appreciation of the complex design procedures prior to the present invention for designing the hardware components for a controller.

FIG. 10 illustrates a flowchart for the vending machine controller system. This flowchart would be entered into the KBSC system by the user through the flowchart editor. Briefly reviewing the flowchart, the controller receives a coin present signal when a coin is received in the coin receiver. State0 and cond0 define a waiting state awaiting deposit of a coin. The symbol CP represents "coin present" and the symbol !CP repre-

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sents "coin not present". Statel and condI determine when the coin has cleared the coin receiver. At state20, after receipt of a coin, the macro instruction ADD3.1 (lc, cv, sum) instructs the system to add lc (last coin) and cv (coin value) and store the result as sum. The macro instruction associated with state21 moves the value in the register sum to cv. The macro CMP.1 at state22 compares the value of cv with PR (price of soft drink) and returns signals EQ, GT and LT. The condition cond2 tests the result of the compare operation CMP.1. If the result is "not greater than" (!GT.CMP.1), then the condition cond3 tests to see whether the result is "equal" (EQ.CMP.1). If the result is "not equal" (!EQ.CMP.1), then control is returned to state0 awaiting the deposit of another coin. If cond3 is EQ, then state4 generates a control signal to dispense a soft drink (droppop) and the macro instruction CLR.1(cv) resets cv to zero awaiting another customer.

If the total coins deposited exceed the price, then state30 produces the action "returncoin". Additionally, the macro DECR.1 (cv) reduces the value of cv by the amount of the returned coin. At state31 cv and PR are again compared. If cv is still greater than PR, then control passes to state30 for return of another coin. The condition cond5 tests whether the result of CMP.2 is EQ and will result in either dispensing a drink (droppop) true or branching to state0 awaiting deposit of another coin. The macros associated with the states shown in FIG. 10 correspond to those defined in Table 1 above and define the particular actions which are to be performed at the respective states.

Appendix A shows the intermediate file or "statelist" produced from the flowchart of FIG. 10. This statelist is produced as output from the EDSIM program 20 and is used as input to the PSCS program 30 (FIG. 3).

FIG. 11 illustrates for each of the macros used in the flowchart of FIG. 10, the corresponding hardware blocks. It will be seen that the comparison macro CMP (A,B) results in the generation of a register for storing value A, a register for storing value B, and a comparator block and also produces control paths to the system controller for the EQ, LT, and GT signals generated as a result of the comparison operation. The addition macro ADD (A,B,C) results in the generation of a register for each of the input values A and B, a register for the output value C, and in the generation of an adder block. The macro DECR (A) results in the generation of a counter block. The PSCS program 30 maps each of the macros used in the flowchart of FIG. 10 to the corresponding hardware components results in the generation of the hardware blocks shown in FIG. 12. In generating the illustrated blocks, the PSCS program 30 relied upon rules 1 and 2 of the above listed example rules.

FIG. 13 illustrates the interconnection of the block of FIG. 12 with data paths and control paths. Rule 3 was used by the data/control path synthesizer program 31 in mapping the data and control paths.

FIG. 14 shows the result of optimizing the circuit by applying rule 4 to eliminate redundant registers. As a result of application of this rule, the registers R2, R3, R7, R8, and R9 in FIG. 13 were removed. FIG. 15 shows the block diagram after further optimization in which redundant comparators are consolidated. This optimization is achieved in the PSCS program 30 by application of rule 5.

Having now defined the system controller block, the other necessary hardware blocks and the data and con-

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trol paths for the integrated circuit, the PSCS program 30 now generates a netlist 15 defining these hardware components and their interconnection requirements. From this netlist the mask data for producing the integrated circuit can be directly produced using available VLSI CAD tools.

```
name rpop;
data path @ic<0:5>, cv<0:5>, sum<0:5>, @pr<0:5>;
{
state4 : state0;
state30 : state31;
state21 : state22;
state20 : state21;
state0 : lcp state0;
state0 : cp state1;
state1 : cp state1;
state1 : lcp state20;
state22 : GT.CMP.1 state30;
state22 : !GT.CMP.1*EQ.CMP.1 state4;
state22 : !GT.CMP.1*EQ.CMP.1 state0;
state31 : GT.CMP.2 state30;
state31 : !GT.CMP.2*EQ.CMP.2 state4;
state31 : !GT.CMP.2*EQ.CMP.2 state0;
state30 : returncoin;
state30 : DECR.1(cv);
state4 : droppop;
state4 : CLR.1(cv);
state31 : CMP.2(cv,pr);
state22 : CMP.1(cv,pr);
state21 : MOVE.1(sum,cv);
state20 : ADD3.1(ic,cv,sum);
}
```

That which I claimed is:

1. A computer-aided design system for designing an application specific integrated circuit directly from architecture independent functional specifications for the integrated circuit, comprising

a macro library defining a set of architecture independent operations comprised of actions and conditions;

input specification means operable by a user for defining architecture independent functional specifications for the integrated circuit, said functional specifications being comprised of a series of operations comprised of actions and conditions, said input specification means including means to permit the user to specify for each operation a macro selected from said macro library;

a cell library defining a set of available integrated circuit hardware cells for performing the available operations defined in said macro library;

cell selection means for selecting from said cell library for each macro specified by said input specification means, appropriate hardware cells for performing the operation defined by the specified macro, said cell selection means comprising an expert system including a knowledge base containing rules for selecting hardware cells from said cell library and inference engine means for selecting appropriate hardware cells from said cell library in accordance with the rules of said knowledge base; and

netlist generator means cooperating with said cell selection means for generating as output from the system a netlist defining the hardware cells which are needed to achieve the functional requirements of the integrated circuit and the connections therebetween.

2. The system as defined in claim 1 wherein said input means comprises means specification for receiving user

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input of a list defining the series of actions and conditions.

3. The system as defined in claim 1 additionally including mask data generator means for generating from said netlist the mask data required to produce an integrated circuit having the specified functional requirements.

4. The system as defined in claim 1 wherein said input means comprises flowchart editor means specification for creating a flowchart having elements representing said series of actions and conditions.

5. The system as defined in claim 4 additionally including flowchart simulator means for simulating the functions defined in the flowchart to enable the user to verify the operation of the integrated circuit.

6. The system as defined in claim 1 additionally including data path generator means cooperating with said cell selection means for generating data paths for the hardware cells selected by said cell selection means.

7. The system as defined in claim 6 wherein said data path generator means comprises a knowledge base containing rules for selecting data paths between hardware cells and inference engine means for selecting data paths between the hardware cells selected by said cell selection means in accordance with the rules of said knowledge base and the arguments of the specified macros.

8. The system as defined in claim 6 additionally including control generator means for generating a controller and control paths for the hardware cells selected by said cell selection means.

9. A computer-aided design system for designing an application specific integrated circuit directly from a flowchart defining architecture independent functional requirements of the integrated circuit comprising

a marco library defining a set of architecture independent operations comprised of actions and conditions;

flowchart editor means operable by a user for creating a flowchart having elements representing said architecture independent operations;

said flowchart editor means including macro specification means for permitting the user to specify for each operation represented in the flowchart a macro selected from said macro library;

a cell library defining a set of available integrated circuit hardware cells for performing the available operations defined in said macro library;

cell selection means for selecting from said cell library for each specified macro, appropriate hardware cells for performing the operation defined by the specified macro, said cell selection means comprising an expert system including a knowledge base containing rules for selecting hardware cells from said cell library and inference engine means for selecting appropriate hardware cells from said cell library in accordance with the rules of said knowledge base; and

data path generator means cooperating with said cell selection means for generating data paths for the hardware cells selected by said cell selector means, said data path generator means comprising a knowledge base containing rules for selecting data paths between hardware cells and inference engine means for selecting data paths between hardware cells selected by said cell selection means in accordance with the rules of said knowledge base and the arguments of the specified macros.

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10. The system as defined in claim 9 additionally including control generator means for generating a controller and control paths for the hardware cells selected by said cell selection means.

11. A computer-aided design system for designing an application specific integrated circuit directly from a flowchart defining architecture independent functional requirements of the integrated circuit, comprising

flowchart editor means operable by a user for creating a flowchart having boxes representing architecture independent actions, diamonds representing architecture independent conditions, and lines with arrows representing transitions between actions and condition and including means for specifying for each box or diamond, a particular action or condition to be performed;

a cell library defining a set of available integrated circuit hardware cells for performing actions and conditions;

a knowledge base containing rules for selecting hardware cells from said cell library and for generating data and control paths for hardware cells; and

expert system means operable with said knowledge base for translating the flowchart defined by said flowchart editor means into a netlist defining the necessary hardware cells and data and control paths required in an integrated circuit having the specified functional requirements.

12. The system as defined in claim 11 including mask data generator means for generating from said netlist the mask data required to produce an integrated circuit having the specified functional requirements.

13. A computer-aided design process for designing an application specific integrated circuit which will perform a desired function comprising

storing a set of definitions of architecture independent actions and conditions;

storing data describing a set of available integrated circuit hardware cells for performing the actions and conditions defined in the stored set;

storing in an expert system knowledge base a set of rules for selecting hardware cells to perform the actions and conditions;

describing for a proposed application specific integrated circuit a series of architecture independent actions and conditions;

specifying for each described action and condition of the series one of said stored definitions which corresponds to the desired action or condition to be performed; and

selecting from said stored data for each of the specified definitions a corresponding integrated circuit hardware cell for performing the desired function of the application specific integrated circuit, said step of selecting a hardware cell comprising applying to the specified definition of the action or condition to be performed, a set of cell selection rules stored in said expert system knowledge base and generating for the selected integrated circuit hardware cells, a netlist defining the hardware cells which are needed to perform the desired function of the integrated circuit and the interconnection requirements therefor.

14. A process as defined in claim 13, including generating from the netlist the mask data required to produce an integrated circuit having the desired function.

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15. A process as defined in claim 13 including the further step of generating data paths for the selected integrated circuit hardware cells.

16. A process as defined in claim 15 wherein said step of generating data paths comprises applying to the selected cells a set of data path rules stored in a knowledge base and generating the data paths therefrom.

17. A process as defined in claim 16 including the further step of generating control paths for the selected integrated circuit hardware cells.

18. A knowledge based design process for designing an application specific integrated circuit which will perform a desired function comprising

storing in a macro library a set of macros defining architecture independent actions and conditions; storing in a cell library a set of available integrated circuit hardware cells for performing the actions and conditions;

storing in a knowledge base set of rules for selecting hardware cells from said cell library to perform the actions and conditions defined by the stored macros;

describing for a proposed application specific integrated circuit a flowchart comprised of elements representing a series of architecture independent

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actions and conditions which carry out the function to be performed by the integrated circuit; specifying for each described action and condition of said series a macro selected from the macro library which corresponds to the action or condition; and applying rules of said knowledge base to the specified macros to select from said cell library the hardware cells required for performing the desired function of the application specific integrated circuit and generating for the selected integrated circuit hardware cells, a netlist defining the hardware cells which are needed to perform the desired function of the integrated circuit and the interconnection requirements therefor.

19. A process as defined in claim 18 also including the steps of

storing in said knowledge base a set of rules for creating data paths between hardware cells, and applying rules of said knowledge base to the specified means to create data paths for the selected hardware cells.

20. A process as defined in claim 19 also including the steps of generating a controller and generating control paths for the selected hardware cells.

\* \* \* \* \*

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## **Exhibit 26**

**United States Patent** [19][11] **Patent Number:** **4,922,432****Kobayashi et al.**[45] **Date of Patent:** **May 1, 1990**

- [54] **KNOWLEDGE BASED METHOD AND APPARATUS FOR DESIGNING INTEGRATED CIRCUITS USING FUNCTIONAL SPECIFICATIONS**
- [75] Inventors: Hideaki Kobayashi, Columbia, S.C.; Masahiro Shindo, Osaka, Japan
- [73] Assignees: International Chip Corporation, Columbia, S.C.; Ricoh Company, Ltd., Tokyo, Japan
- [21] Appl. No.: 143,821
- [22] Filed: Jan. 13, 1988
- [51] Int. Cl.<sup>3</sup> ..... G06F 15/60
- [52] U.S. Cl. .... 364/490; 364/489; 364/488; 364/521
- [58] Field of Search ..... 364/488-491, 364/521, 300, 513

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Primary Examiner—Felix D. Gruber

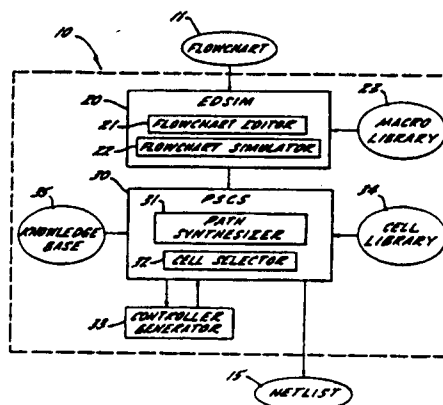
Assistant Examiner—V. N. Trans

Attorney, Agent, or Firm—Bell, Seltzer, Park & Gibson

[57]

**ABSTRACT**

The present invention provides a computer-aided design system and method for designing an application specific integrated circuit which enables a user to define functional architecture independent specifications for the integrated circuit and which translates the functional architecture independent specifications into the detailed information needed for directly producing the integrated circuit. The functional architecture independent specifications of the desired integrated circuit can be defined at the functional architecture independent level in a flowchart format. From the flowchart, the system and method uses artificial intelligence and expert systems technology to generate a system controller, to select the necessary integrated circuit hardware cells needed to achieve the functional specifications, and to generate data and control paths for operation of the integrated circuit. This list of hardware cells and their interconnection requirements is set forth in a netlist. From the netlist it is possible using known manual techniques or existing VLSI CAD layout systems to generate the detailed chip level topological information (mask data) required to produce the particular application specific integrated circuit.

**20 Claims, 12 Drawing Sheets**

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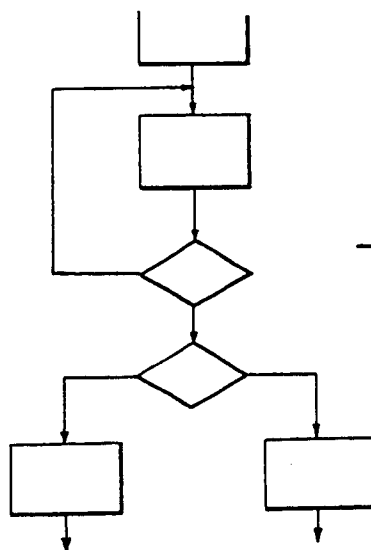


FIG. 1a.  
FUNCTIONAL  
LEVEL

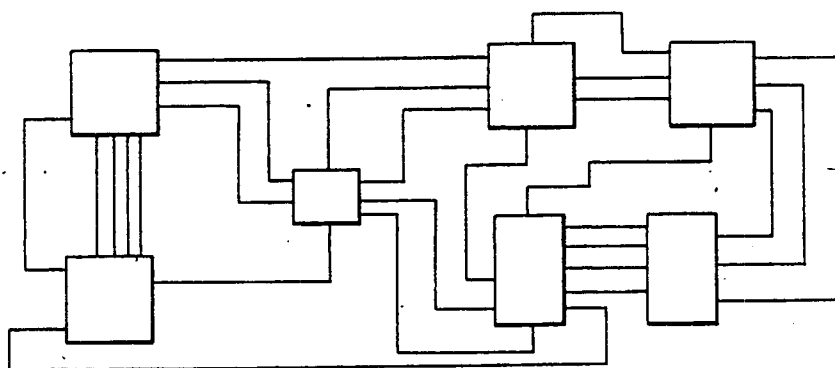


Fig. 1b.  
STRUCTURAL LEVEL

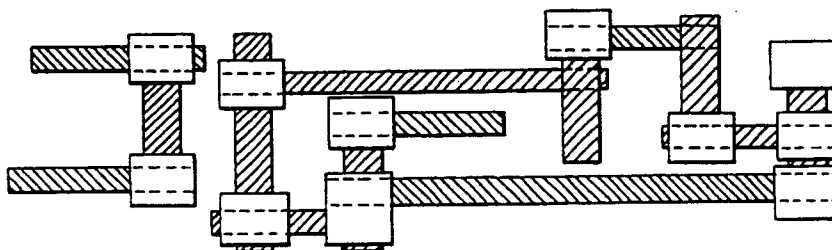


Fig. 1c.  
PHYSICAL LAYOUT LEVEL

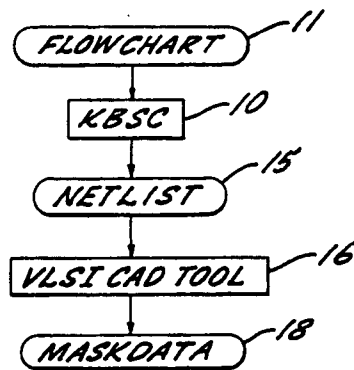


FIG. 2.

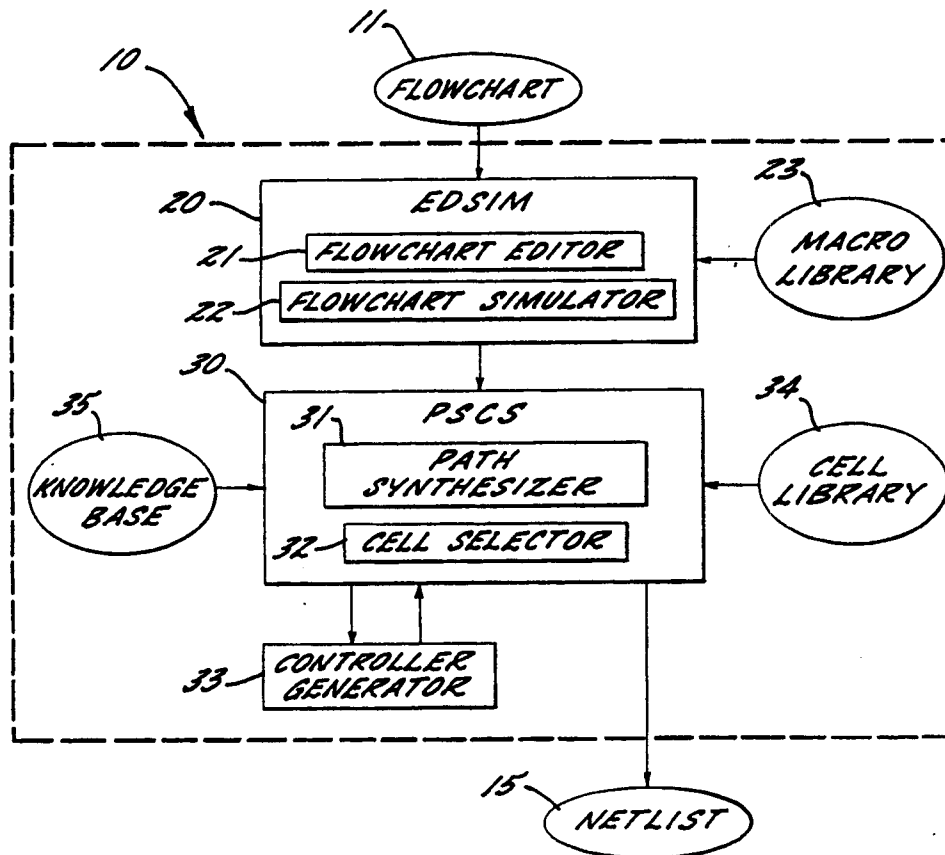
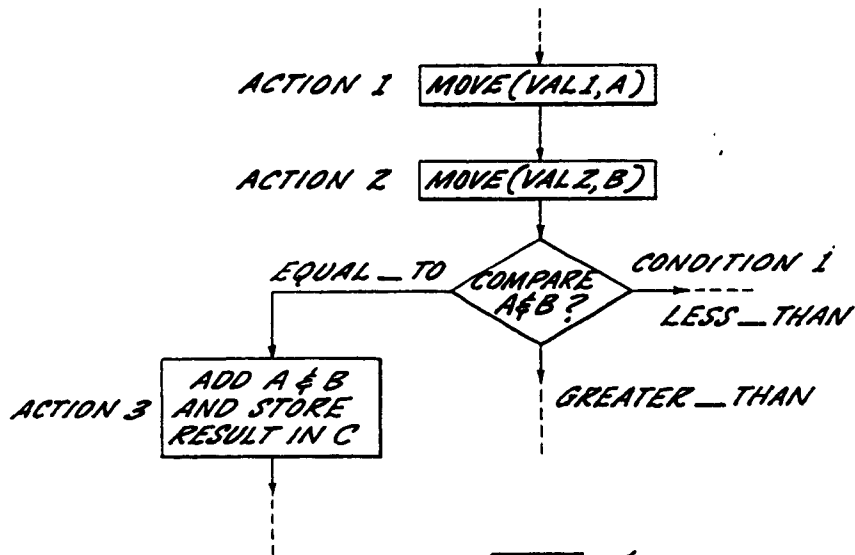
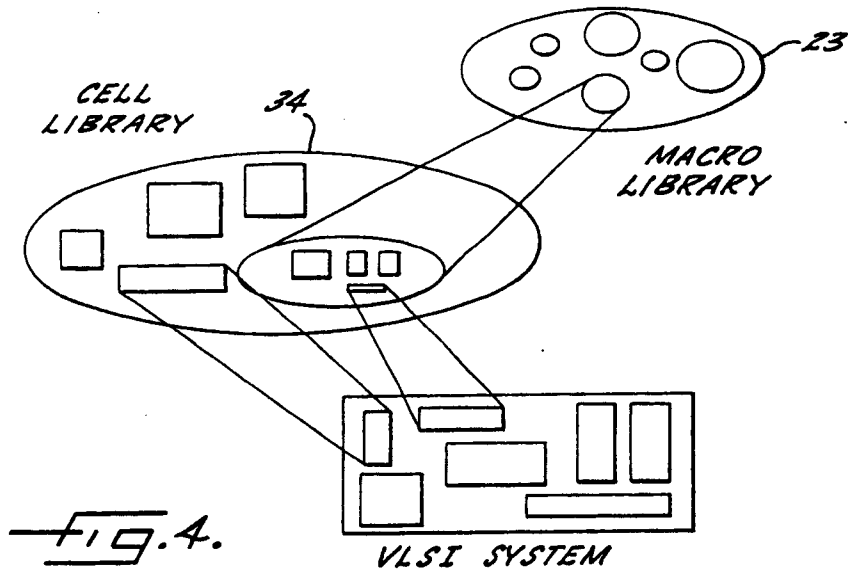


FIG. 3.



**FIG. 5.**

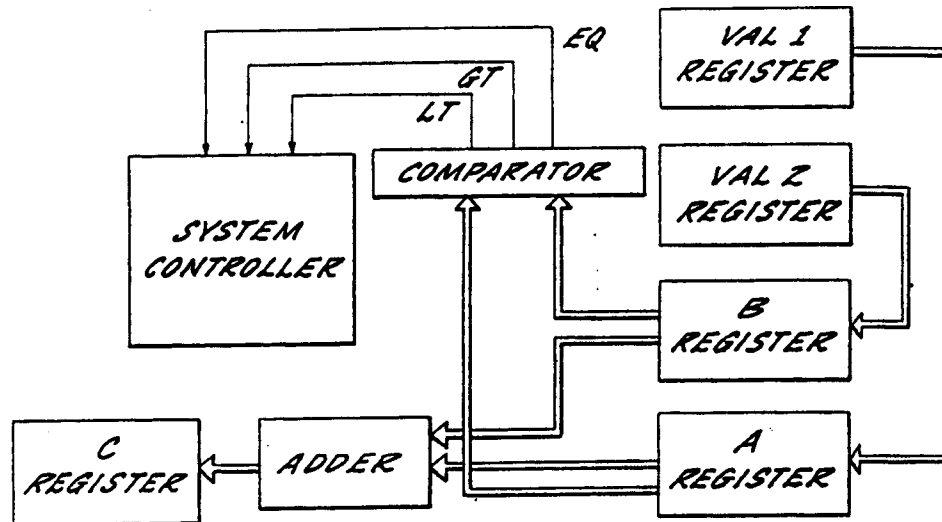


FIG. 6.

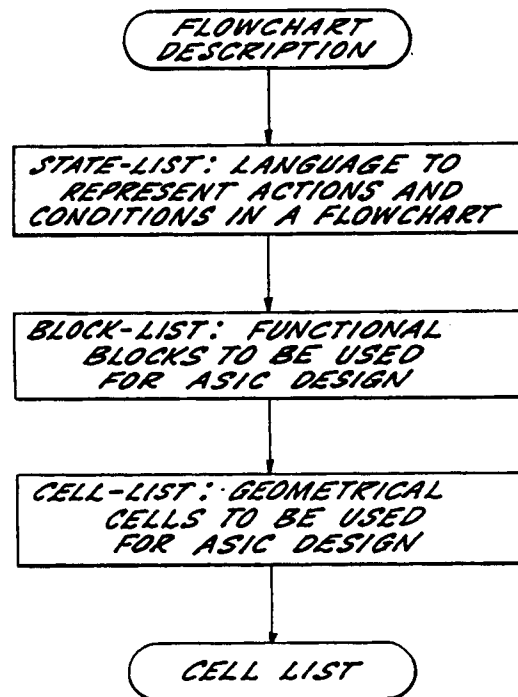


FIG. 9.

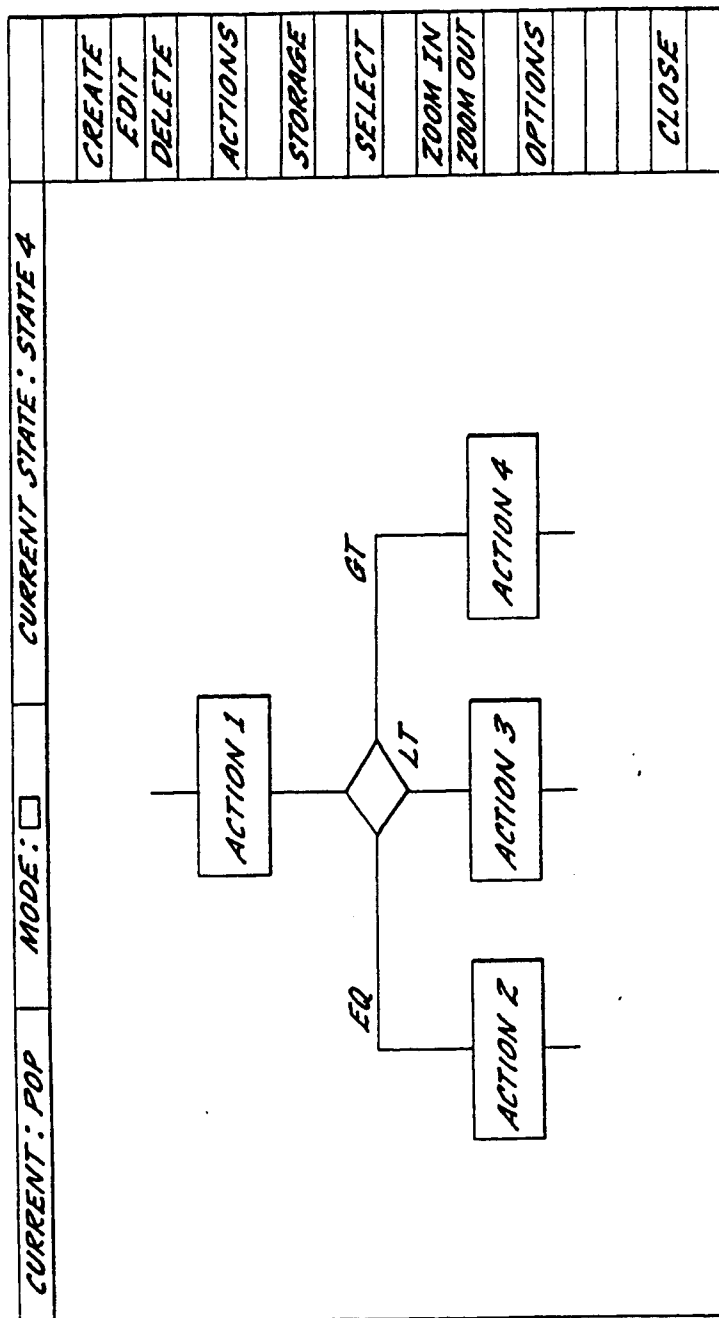


FIG. 7.

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EDIT DATA	SET BREAKS	STEP	HISTORY ON	CANCEL
SHOW DATA	CLEAR BREAKS	EXECUTE	DETAIL	HELP
SET STATE	SHOW BREAKS	STOP		CLOSE
<p>*** READY ***</p>				

FIG. 8.

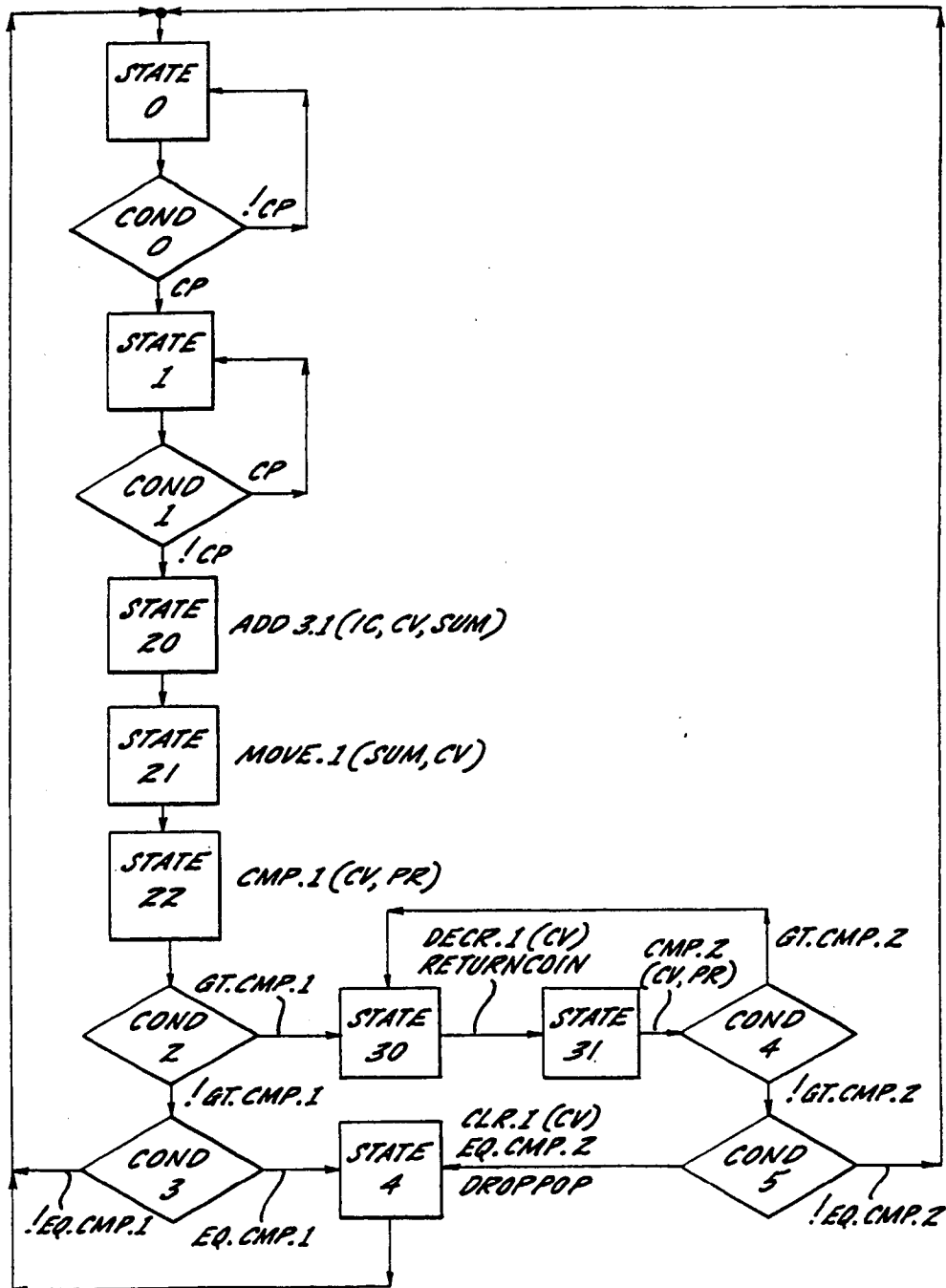


FIG. 10.

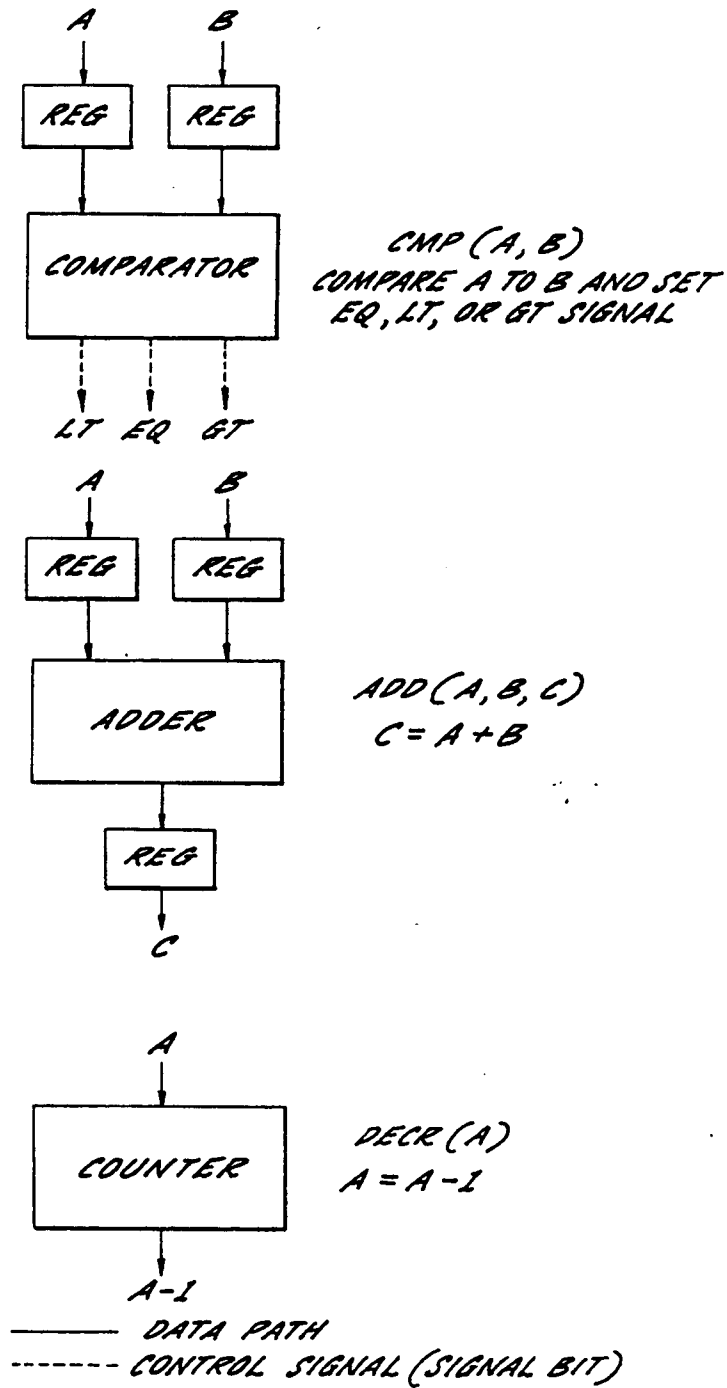
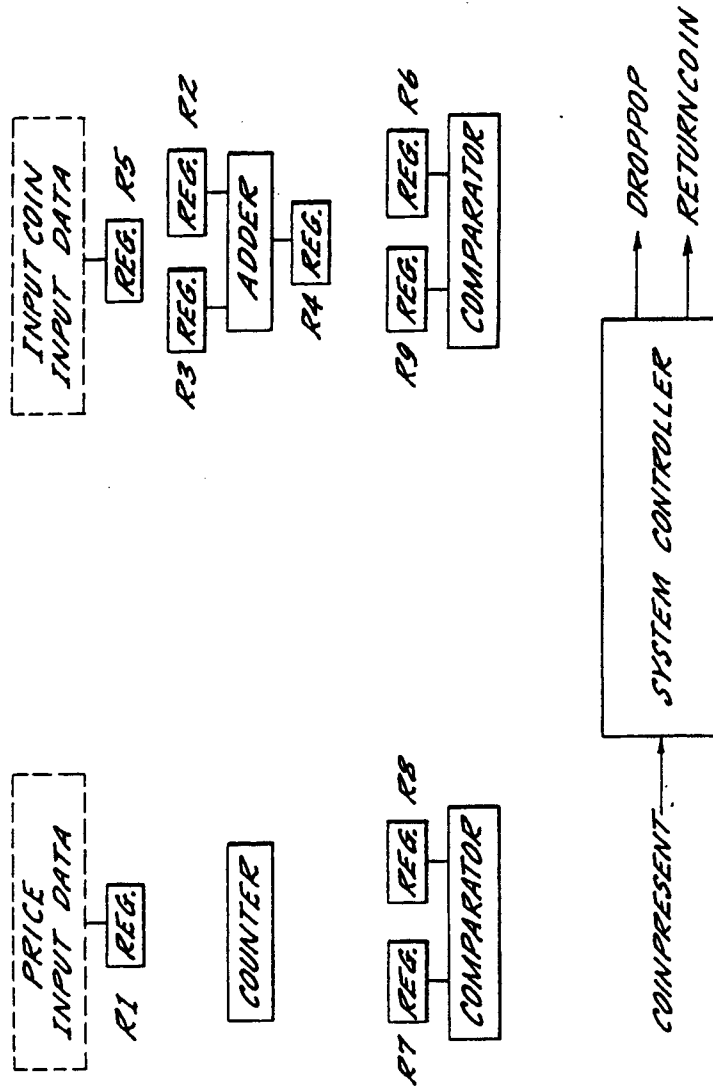


Fig. 11.

FIG. 12.

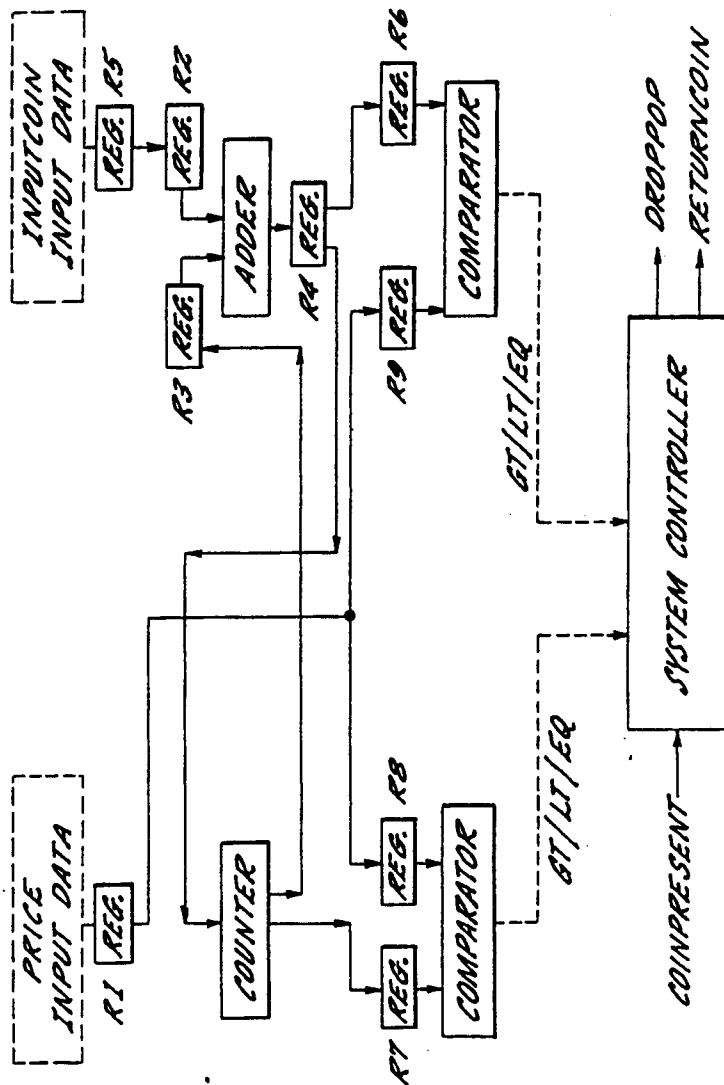


FIG. 13.

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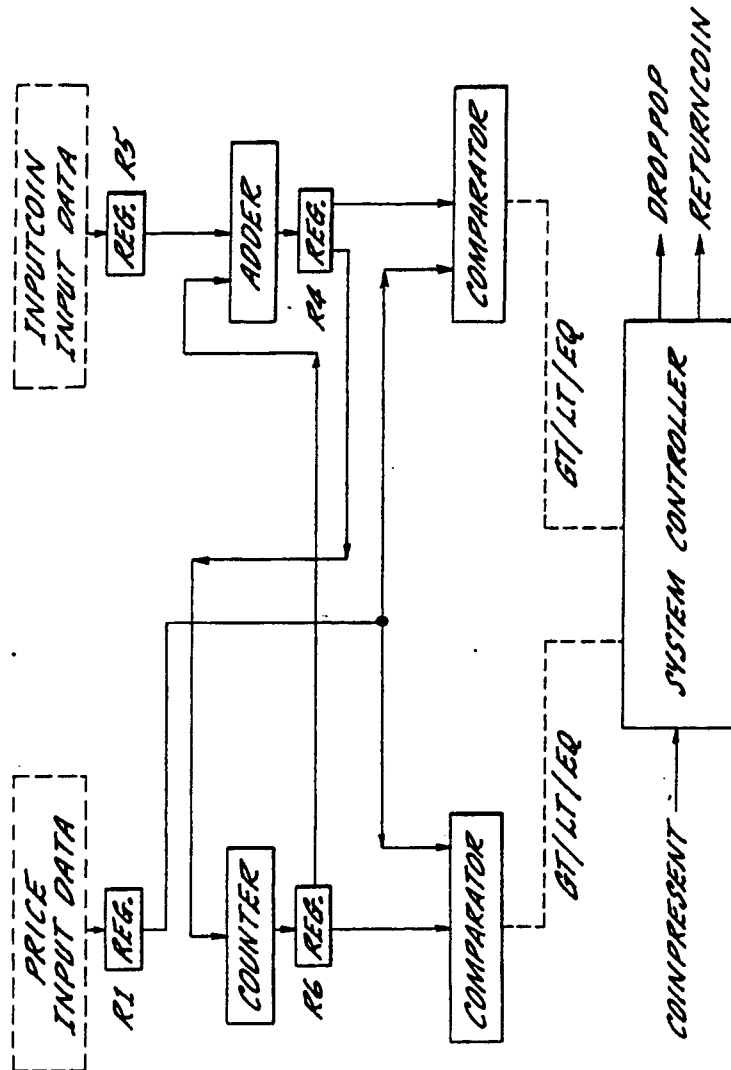


FIG. 14.

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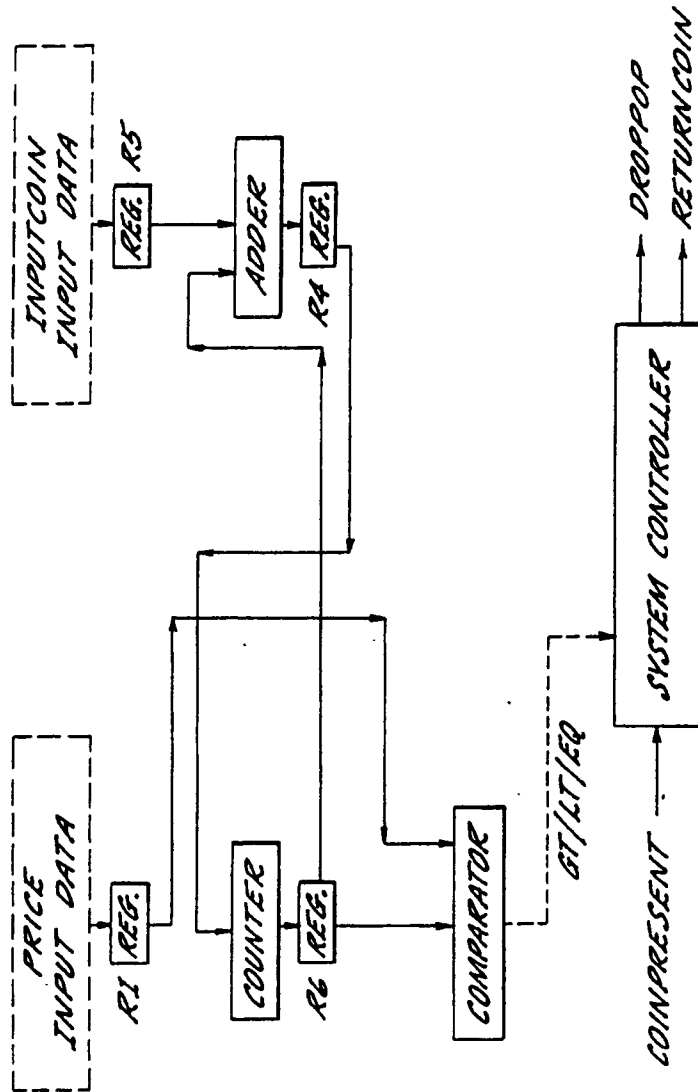


FIG. 15.

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# KNOWLEDGE BASED METHOD AND APPARATUS FOR DESIGNING INTEGRATED CIRCUITS USING FUNCTIONAL SPECIFICATIONS

## FIELD AND BACKGROUND OF THE INVENTION

This invention relates to the design of integrated circuits, and more particularly relates to a computer-aided method and apparatus for designing integrated circuits.

An application specific integrated circuit (ASIC) is an integrated circuit chip designed to perform a specific function, as distinguished from standard, general purpose integrated circuit chips, such as microprocessors, memory chips, etc. A highly skilled design engineer having specialized knowledge in VLSI circuit design is ordinarily required to design a ASIC. In the design process, the VLSI design engineer will consider the particular objectives to be accomplished and tasks to be performed by the integrated circuit and will create structural level design specifications which define the various hardware components required to perform the desired function, as well as the interconnection requirements between these components. A system controller must also be designed for synchronizing the operations of these components. This requires an extensive and all encompassing knowledge of the various hardware components required to achieve the desired objectives, as well as their interconnection requirements, signal level compatibility, timing compatibility, physical layout, etc. At each design step, the designer must do tedious analysis. The design specifications created by the VLSI design engineer may, for example, be in the form of circuit schematics, parameters or specialized hardware description languages (HDLs).

From the structural level design specifications, the description of the hardware components and interconnections is converted to a physical chip layout level description which describes the actual topological characteristics of the integrated circuit chip. This physical chip layout level description provides the mask data needed for fabricating the chip.

Due to the tremendous advances in very large scale integration (VLSI) technology, highly complex circuit systems are being built on a single chip. With their complexity and the demand to design custom chips at a faster rate, in large quantities, and for an ever increasing number of specific applications, computer-aided design (CAD) techniques need to be used. CAD techniques have been used with success in design and verification of integrated circuits, at both the structural level and at the physical layout level. For example, CAD systems have been developed for assisting in converting VLSI structural level descriptions of integrated circuits into the physical layout level topological mask data required for actually producing the chip. Although the presently available computer-aided design systems greatly facilitate the design process, the current practice still requires highly skilled VLSI design engineers to create the necessary structural level hardware descriptions.

There is only a small number of VLSI designers who possess the highly specialized skills needed to create structural level integrated circuit hardware descriptions. Even with the assistance of available VLSI CAD tools, the design process is time consuming and the probability of error is also high because of human in-

volvements. There is a very significant need for a better and more cost effective way to design custom integrated circuits.

## SUMMARY OF THE INVENTION

In accordance with the present invention a CAD (computer-aided design) system and method is provided which enables a user to define the functional requirements for a desired target integrated circuit, using an easily understood functional architecture independent level representation, and which generates therefrom the detailed information needed for directly producing an application specific integrated circuit (ASIC) to carry out those specific functions. Thus, the present invention, for the first time, opens the possibility for the design and production of ASICs by designers, engineers and technicians who may not possess the specialized expert knowledge of a highly skilled VLSI design engineer.

The functional architecture independent specifications of the desired ASIC can be defined in a suitable manner, such as in list form or preferably in a flowchart format. The flowchart is a highly effective means of describing a sequence of logical operations, and is well understood by software and hardware designers of varying levels of expertise and training. From the flowchart (or other functional specifications), the system and method of the present invention translates the functional architecture independent specifications into structural an architecture specific level definition of an integrated circuit, which can be used directly to produce the ASIC. The structural level definition includes a list of the integrated circuit hardware cells needed to achieve the functional specifications. These cells are selected from a cell library of previously designed hardware cells of various functions and technical specifications. The system also generates data paths among the selected hardware cells. In addition, the present invention generates a system controller and control paths for the selected integrated circuit hardware cells. The list of hardware cells and their interconnection requirements may be represented in the form of a netlist. From the netlist it is possible using either known manual techniques or existing VLSI CAD layout systems to generate the detailed chip level geometrical information (e.g. mask data) required to produce the particular application specific integrated circuit in chip form.

The preferred embodiment of the system and method of the present invention which is described more fully hereinafter is referred to as a Knowledge Based Silicon Compiler (KBSC). The KBSC is an ASIC design methodology based upon artificial intelligence and expert systems technology. The user interface of KBSC is a flowchart editor which allows the designer to represent VLSI systems in the form of a flowchart. The KBSC utilizes a knowledge based expert system, with a knowledge base extracted from expert ASIC designers with a high level of expertise in VLSI design to generate from the flowchart a netlist which describes the selected hardware cells and their interconnection requirements.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood by reference to the detailed description which follows, taken in connection with the accompanying drawings, in which

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FIG. 1a illustrates a functional level design representation of a portion of a desired target circuit, shown in the form of a flowchart;

FIG. 1b illustrates a structural level design representation of an integrated circuit;

FIG. 1c illustrates a design representation of a circuit at a physical layout level, such as would be utilized in the fabrication of an integrated circuit chip;

FIG. 2 is a block schematic diagram showing how integrated circuit mask data is created from flowchart descriptions by the KBSC system of the present invention;

FIG. 3 is a somewhat more detailed schematic illustration showing the primary components of the KBSC system;

FIG. 4 is a schematic illustration showing how the ASIC design system of the present invention draws upon selected predefined integrated circuit hardware cells from a cell library;

FIG. 5 is an example flowchart defining a sequence of functional operations to be performed by an integrated circuit;

FIG. 6 is a structural representation showing the hardware blocks and interconnection requirements for the integrated circuit defined in FIG. 5;

FIG. 7 is an illustration of the flowchart editor window;

FIG. 8 is an illustration of the flowchart simulator window;

FIG. 9 is an illustration of the steps involved in cell list generation;

FIG. 10 is an example flowchart for a vending machine system;

FIG. 11 illustrates the hardware components which correspond to each of the three macros used in the flowchart of FIG. 10;

FIG. 12 is an initial block diagram showing the hardware components for an integrated circuit as defined in the flowchart of FIG. 10;

FIG. 13 is a block diagram corresponding to FIG. 12 showing the interconnections between blocks;

FIG. 14 is a block diagram corresponding to FIG. 13 after register optimization; and

FIG. 15 is a block diagram corresponding to FIG. 14 after further optimization.

#### DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

FIGS. 1a, 1b and 1c illustrate three different levels of representing the design of an integrated circuit. FIG. 1a shows a functional (or behavioral) representation architecture independent in the form of a flowchart. A flowchart is a graphic representation of an algorithm and consists of two kinds of blocks or states, namely actions and conditions (decisions). Actions are conventionally represented in the flowchart by a rectangle or box, and conditions are represented by a diamond. Transitions between actions and conditions are represented by lines with arrows. FIG. 1b illustrates a structural (or logic) level representation of an integrated circuit. In this representation, blocks are used to represent integrated architecture specific circuit hardware components for performing various functions, and the lines interconnecting the blocks represent paths for the flow of data or control signals between the blocks. The blocks may, for example, represent hardware components such as adders, comparators, registers, system controllers, etc. FIG. 1c illustrates a physical layout level representation

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of an integrated circuit design, which provides the detailed mask data necessary to actually manufacture the devices and conductors which together comprise integrated circuit.

As noted earlier, the design of an integrated circuit at the structural level requires a design engineer with highly specialized skills and expertise in VLSI design. In the KBSC system of the present invention, however, integrated circuits can be designed at a functional level because the expertise in VLSI design is provided and applied by the invention. Allowing the designer to work with flowcharts instead of logic circuit schematics simplifies the task of designing custom integrated circuits, making it quicker, less expensive and more reliable. The designer deals with an algorithm using simple flowcharts at an architecture independent functional (behavioral) level, and needs to know only the necessary logical steps to complete a task, rather than the specific means for accomplishing the task. Designing with flowcharts requires less work in testing because flowcharts allow the designer to work much closer to the algorithm. On the other hand, previously existing VLSI design tools require the designer to represent an algorithm with complex circuit schematics at a structural level, therefore requiring more work in testing. Circuit schematics make it harder for the designer to cope with the algorithm function which needs to be incorporated into the target design because they intermix the hardware and functional considerations. Using flowcharts to design custom integrated circuits will allow a large number of system designers to access VLSI technology, where previously only a small number of designers had the knowledge and skills to create the necessary structural level hardware descriptions.

The overall system flow is illustrated in FIG. 2. The user enters the functional specifications of the circuit into the knowledge based silicon compiler (KBSC) 10 in the form of a flowchart 11. The KBSC 10 then generates a netlist 15 from the flowchart. The netlist 15 includes a custom generated system controller, all other hardware cells required to implement the necessary operations, and interconnection information for connecting the hardware cells and the system controller. The netlist can be used as input to any existing VLSI layout and routing tool 16 to create mask data 18 for geometrical layout.

#### System Overview

The primary elements or modules which comprise the KBSC system are shown in FIG. 3. In the embodiment illustrated and described herein, these elements or modules are in the form of software programs, although persons skilled in the appropriate art will recognize that these elements can easily be embodied in other forms, such as in hardware.

Referring more particularly to FIG. 3, it will be seen that the KBSC system 10 includes a program 20 called EDSIM, which comprises a flowchart editor 21 for creating and editing flowcharts and a flowchart simulator 22 for simulation and verification of flowcharts. Actions to be performed by each of the rectangles represented in the flowchart are selected from a macro library 23. A program 30 called PSCS (path synthesizer and cell selector) includes a data and control path synthesizer module 31, which is a knowledge based system for data and control path synthesis. PSCS also includes a cell selector 32 for selecting the cells required for system design. The cell selector 32 selects from a cell

library 34 of previously designed hardware cells the appropriate cell or cells required to perform each action and condition represented in the flowchart. A controller generator 33 generates a custom designed system controller for controlling the operations of the other hardware cells. The knowledge base 35 contains ASIC design expert knowledge required for data path synthesis and cell selection. Thus, with a functional flowchart input, PSCS generates a system controller, selects all other hardware cells, generates data and control paths, and generates a netlist describing all of this design information.

The KBSC system employs a hierarchal cell selection ASIC design approach, as is illustrated in FIG. 4. Rather than generating every required hardware cell from scratch, the system draws upon a cell library 34 of previously designed, tested and proven hardware cells of various types and of various functional capabilities with a given type. The macro library 23 contains a set of macros defining various actions which can be specified in the flowchart. For each macro function in the macro library 23 there may be several hardware cells in the cell library 34 of differing geometry and characteristics capable of performing the specified function. Using a rule based expert system with a knowledge base 35 extracted from expert ASIC designers, the KBSC system selects from the cell library 34 the optimum cell for carrying out the desired function.

Referring again to FIG. 3, the cells selected by the cell selector 32, the controller information generated by the controller generator 33 and the data and control paths generated by the data/control path synthesizer 31 are all utilized by the PSCS program 30 to generate the netlist 15. The netlist is a list which identifies each block in the circuit and the interconnections between the respective inputs and outputs of each block. The netlist provides all the necessary information required to produce the integrated circuit. Computer-aided design systems for cell placement and routing are commercially available which will receive netlist data as input and will lay out the respective cells in the chip, generate the necessary routing, and produce mask data which can be directly used by a chip foundry in the fabrication of integrated circuits.

#### System Requirements

The KBSC system can be operated on a suitable programmed general purpose digital computer. By way of example, one embodiment of the system is operated in a work station environment such as Sun3 and VAXStation-II/GPX Running UNIX Operating System and X Window Manager. The work station requires a minimum of 8 megabytes of main storage and 20 megabytes of hard disk space. The monitor used is a color screen with 8-bit planes. The software uses C programming language and INGRES relational data base.

The human interface is mainly done by the use of pop up menus, buttons, and a special purpose command language. The permanent data of the integrated circuit design are stored in the data base for easy retrieval and update. Main memory stores the next data temporarily, executable code, design data (flowchart, logic, etc.), data base (cell library), and knowledge base. The CPU performs the main tasks of creating and simulating flowcharts and the automatic synthesis of the design.

#### Flowchart Example

To describe the mapping of a flowchart to a netlist, consider an example flowchart shown in FIG. 5, which is of part of a larger overall system. In this illustrative flowchart, two variables, VAL1 and VAL2 are compared and if they are equal, they are added together. In this instance, the first action (Action 1) involves moving the value of variable VAL1 to register A. The second action comprises moving the value of variable VAL2 to register B. Condition 1 comprises comparing the values in registers A and B. Action 3 comprises adding the values of registers A and B and storing the result in register C.

In producing an integrated circuit to carry out the function defined in FIG. 5, the KBSC maps the flowchart description of the behavior of the system to interconnection requirements between hardware cells. The hardware cells are controlled by a system controller which generates all control signals. There are two types of variables involved in a system controller:

(1) Input variables: These are generated by hardware cells, and/or are external input to the controller. These correspond to conditions in the flowchart.

(2) Output variables: These are generated by the system controller and correspond to actions in the flowchart.

FIG. 6 illustrates the results of mapping the flowchart of FIG. 5 onto hardware cells. The actions and the conditions in the flowchart are used for cell selection and data and control path synthesis. The VAL1 register and VAL2 register and the data paths leading therefrom have already been allocated in actions occurring before Action 1 in our example. Action 1 causes generation of the data register A. Similarly, Action 2 causes the allocation of data register B. The comparator is allocated as a result of the comparison operation in Condition 1. The comparison operation is accomplished by (1) selecting a comparator cell, (2) mapping the inputs of the comparator cell to registers A and B, (3) generating data paths to connect the comparator with the registers A and B and (4) generating input variables corresponding to equal to, greater than, and less than for the system controller. Similarly the add operation in Action 3 causes selection of the adder cell, mapping of the adder parameters to the registers and creating the data paths.

Following this methodology, a block list can be generated for a given flowchart. This block list consists of a system controller and as many other blocks as may be required for performing the necessary operations. The blocks are connected with data paths, and the blocks are controlled by the system controller through control paths. These blocks can be mapped to the cells selected from a cell library to produce a cell list.

#### Interactive Flowchart Editor and Simulator

The creation and verification of the flowchart is the first step in the VLSI design methodology. The translation from an algorithm to an equivalent flowchart is performed with the Flowchart Editor 21 (FIG. 3). The verification of the edited flowchart is performed by the Flowchart Simulator 22. The Flowchart Editor and Simulator are integrated into one working environment for interactive flowchart editing, with a designer friendly interface.

EDSIM is the program which contains the Flowchart Editor 21 and the Flowchart Simulator 22. It also provides functions such as loading and saving flow-

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charts. EDSIM will generate an intermediate file, called a statelist, for each flowchart. This file is then used by the PSCS program 30 to generate a netlist.

#### Flowchart Editor

The Flowchart Editor 21 is a software module used for displaying, creating, and editing the flowchart. This module is controlled through the flowchart editing window illustrated in FIG. 7. Along with editing functions the Flowchart Editor also provides checking of design errors.

The following is a description of the operations of the Flowchart Editor. The main editing functions include, create, edit, and delete states, conditions, and transitions. The create operation allows the designer to add a new state, condition, or transitions to a flowchart. Edit allows the designer to change the position of a state, condition or transition, and delete allows the designer to remove a state, condition or transition from the current flowchart. States which contain actions are represented by boxes, conditions are represented by diamonds, and transitions are represented by lines with arrows showing the direction of the transition.

Edit actions allows the designer to assign actions to each box. These actions are made up of macro names and arguments. An example of arguments is the setting and clearing of external signals. A list of basic macros available in the macro library 23 is shown in Table 1.

TABLE 1

Macro	Description
ADD (A,B,C)	C = A + B
SUB (A,B,C)	C = A - B
MULT (A,B,C)	C = A * B
DIV (A,B,C)	C = A div B
DECR (A)	A = A - 1
INCR (A)	A = A + 1
CLR (A)	A = 0
REG (A,B)	B = A
CMP (A,B)	Compare A to B and set EQ,LT,GT signals
CMP0 (A)	Compare A to 0 and set EQ,LT,GT signals
NEGATE (A)	A = NOT (A)
MOD (A,B,C)	C = A Modulus B
POW (A,B,C)	C = A <sup>B</sup>
DC2 (A,S1,S2,S3,S4)	Decode A into S1,S2,S3,S4
EC2 (S1,S2,S3,S4,A)	Encode S1,S2,S3,S4 into A
MOVE (A,B)	B = A
CALL sub-flowchart (A,B,...)	Call a sub-flowchart. Pass A,B...
START (A,B,...)	Beginning state of a sub-flowchart
STOP (A,B,...)	Ending state of a sub-flowchart

The Flowchart Editor also provides a graphical display of the flowchart as the Flowchart Simulator simulates the flowchart. This graphical display consists of boxes, diamonds, and lines as shown in FIG. 7. All are drawn on the screen and look like a traditional flowchart. By displaying the flowchart on the screen during simulation it allows the designer to design and verify the flowchart at the same time.

#### Flowchart Simulator

The Flowchart Simulator 22 is a software module used for simulating flowcharts. This module is controlled through the simulator window illustrated in FIG. 8. The Flowchart Simulator simulates the transitions between states and conditions in a flowchart. The following is a list of the operations of the Flowchart Simulator:

edit data—Change the value of a register or memory.

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set state—Set the next state to be simulated.

set detail or summary display—Display summary or detail information during simulation.

set breaks—Set a breakpoint.

clear breaks—Clear all breakpoints.

show breaks—Display current breakpoints.

step—Step through one transition.

execute—Execute the flowchart.

stop—Stop executing of the flowchart. history ON or

history OFF—Set history recording on or off.

cancel—Cancel current operation.

help—Display help screen.

close—Close the simulator window.

The results of the simulation are displayed within the simulator window. Also the editor window will track the flowchart as it is being simulated. This tracking of the flowchart makes it easy to edit the flowchart when an error is found.

#### Cell Selection

The Cell Selector 32 is a knowledge based system for selecting a set of optimum cells from the cell library 34 to implement a VLSI system. The selection is based on functional descriptions in the flowchart, as specified by the macros assigned to each action represented in the flowchart. The cells selected for implementing a VLSI system depend on factors such as cell function, fabrication technology used, power limitations, time delays etc. The cell selector uses a knowledge base extracted from VLSI design experts to make the cell selection.

To design a VLSI system from a flowchart description of a user application, it is necessary to match the functions in a flowchart with cells from a cell library. This mapping needs the use of artificial intelligence techniques because the cell selection process is complicated and is done on the basis of a number of design parameters and constraints. The concept used for cell selection is analogous to that used in software compilation. In software compilation a number of subroutines are linked from libraries. In the design of VLSI systems, a functional macro can be mapped to library cell.

FIG. 4 illustrates the concept of hierarchical cell selection. The cell selection process is performed in two steps:

- (1) selection of functional macros
- (2) selection of geometrical cells

A set of basic macros is shown in Table 1. A macro corresponds to an action in the flowchart. As an example, consider the operation of adding A and B and storing the result in C. This function is mapped to the addition macro ADD(X, Y, Z). The flowchart editor and flowchart simulator are used to draw the rectangles, diamonds and lines of the flowchart, to assign a macro selected from the macro library 23 to each action represented in the flowchart, and to verify the functions in flowcharts. The flowchart is converted into an intermediate form (statelist) and input to the Cell Selector.

The Cell Selector uses a rule based expert system to select the appropriate cell or cells to perform each action. If the cell library has a number of cells with different geometries for performing the operation specified by the macro, then an appropriate cell can be selected on the basis of factors such as cell function, process technology used, time delay, power consumption, etc.

The knowledge base of Cell Selector 32 contains information (rules) relating to:

- (1) selection of macros
- (2) merging two macros

- (3) mapping of macros to cells
- (4) merging two cells
- (5) error diagnostics

The above information is stored in the knowledge base 35 as rules.

#### Cell List Generation

FIG. 9 shows the cell list generation steps. The first step of cell list generation is the transformation of the flowchart description into a structure that can be used by the Cell Selector. This structure is called the statelist. The blocklist is generated from the statelist by the inference engine. The blocklist contains a list of the functional blocks to be used in the integrated circuit. Rules of the following type are applied during this stage.

map arguments to data paths

map actions to macros

connect these blocks

Rules also provide for optimization and error diagnostics at this level.

The cell selector maps the blocks to cells selected from the cell library 34. It selects an optimum cell for a block. This involves the formulation of rules for selecting appropriate cells from the cell library. Four types of information are stored for each cell. These are:

- (1) functional level information: description of the cell at the register transfer level.
- (2) logic level information: description in terms of flip-flops and gates.
- (3) circuit level information: description at the transistor level.
- (4) Layout level information: geometrical mask level specification.

The attributes of a cell are:

cell name  
description  
function  
width  
height  
status  
technology  
minimum delay  
typical delay  
maximum delay  
power  
file  
designer  
date  
comment  
inspector

In the cell selection process, the above information can be used. Some parameters that can be used to map macros to cells are:

- (1) name of macro
- (2) function to be performed
- (3) complexity of the chip
- (4) fabrication technology
- (5) delay time allowed
- (6) power consumption
- (7) bit size of macro data paths

#### Netlist Generation

The netlist is generated after the cells have been selected by PSCS. PSCS also uses the macro definitions for connecting the cell terminals to other cells. PSCS uses the state-to-state transition information from an intermediate form representation of a flowchart (i.e. the

statelist) to generate a netlist. PSCS contains the following knowledge for netlist generation:

- (1) Data path synthesis
- (2) Data path optimization
- (3) Macro definitions
- (4) Cell library
- (5) Error detection and correction

The above information is stored in the knowledge base 35 as rules. Knowledge engineers help in the formulation of these rules from ASIC design experts. The macro library 23 and the cell library 34 are stored in a database of KBSC.

A number of operations are performed by PSCS. The following is a top level description of PSCS operations:

- (1) Read the flowchart intermediate file and build a statelist.

- (2) current\_context = START

- (3) Start the inference engine and load the current context rules.

- (4) Perform one of the following operations depending upon current\_context:

- (a) Modify the statelist for correct implementation.

- (b) Create blocklist, macrolist and data paths.

- (c) Optimize blocklist and datapath list and perform error checks.

- (d) Convert blocks to cells.

- (e) Optimize cell list and perform error checks.

- (f) Generate netlist.

- (g) Optimize netlist and perform error checks and upon completion Goto 7.

- (5) If current\_context has changed, load new context rules.

- (6) Goto 4.

- (7) Output netlist file and stf files and Stop.

In the following sections, operations mentioned in step 4 are described. The Rule Language and PSCS display are also described.

#### Rule Language

The rule language of PSCS is designed to be declarative and to facilitate rule editing. In order to make the expert understand the structure of the knowledge base, the rule language provides means for knowledge representation. This will enable the format of data structures to be stated in the rule base, which will enable the expert to refer to them and understand the various structures used by the system. For example, the expert can analyze the structure of wire and determine its components. The expert can then refer these components into rules. If a new object has to be defined, then the expert can declare a new structure and modify some existing structure to link to this new structure. In this way, the growth of the data structures can be visualized better by the expert. This in turn helps the designer to update and append rules.

The following features are included in the rule language:

- (i) Knowledge representation in the form of a record structure.

- (ii) Conditional expressions in the antecedent of a rule.

- (iii) Facility to create and destroy structure in rule actions.

- (iv) The assignment statement in the action of a rule.

- (v) Facility for input and output in rule actions.

- (vi) Provide facility to invoke C functions from rule actions.

The rule format to be used is as follows:

The rule format to be used is as follows:		
Rule	<number>	<context>
IF {	<if-clause>	
}		
Then {	<then-clause>	
}		
where	<number>	rule number
	<context>	context in which this rule is active
	<if-clause>	the condition part of the rule
	<then-clause>	the action part of the rule

### Inference Strategy

The inference strategy is based on a fast pattern matching algorithm. The rules are stored in a network and the requirement to iterate through the rules is avoided. This speeds up the execution. The conflict resolution strategy to be used is based on the following:

(1) The rule containing the most recent data is selected.

(2) The rule which has the most complex condition is selected.

(3) The rule declared first is selected.

### Rule Editor

PSCS provides an interactive rule editor which enables the expert to update the rule set. The rules are stored in a database so that editing capabilities of the database package can be used for rule editing. To perform this operation the expert needs to be familiar with the various knowledge structures and the inferencing process. If this is not possible, then the help of a knowledge engineer is needed.

PSCS provides a menu from which various options can be set. Mechanisms are provided for setting various debugging flags and display options, and for the overall control of PSCS.

Facility is provided to save and display the blocklist created by the user. The blocklist configuration created by the user can be saved in a file and later be printed with a plotter. Also the PSCS display can be reset to restart the display process.

PSCS Example Rules:		
Rule 1	IF	no blocks exist
	THEN	generate a system controller.
Rule 2	IF	a state exists which has a macro AND this macro has not been mapped to a block
	THEN	find a corresponding macro in the library and generate a block for this macro.
Rule 3	IF	there is a transition between two states AND there are macros in these states using the same argument
	THEN	make a connection from a register corresponding to the first macro to another register corresponding to the second macro.
Rule 4	IF	a register has only a single connection from another register
	THEN	combine these registers into a single register.
Rule 5	IF	there are two comparators AND input data widths are of the same size AND

### -continued

PSCS Example Rules:		
		one input of these is same AND the outputs of the comparators are used to perform the same operation. combine these comparators into a single comparator.
5	THEN	
Rule 6	IF	there is a data without a register
	THEN	allocate a register for this data.
10	Rule 7	IF
	IF	all the blocks have been interconnected AND a block has a few terminals not connected
	THEN	remove the block and its terminals, or issue an error message.
15	Rule 8	IF
	IF	memory is to be used, but a block has not been created for it
	THEN	create a memory block with data, address, read and write data and control terminals.
20	Rule 9	IF
	IF	a register has a single connection to a counter
	THEN	combine the register and the counter; remove the register and its terminals.
25	Rule 10	IF
	IF	there are connections to a terminal of a block from many different blocks
	THEN	insert a multiplexor; remove the connections to the terminals and connect them to the input of the multiplexor; connect the output of the multiplexor to the input of the block.

Additional rules address the following points:  
remove cell(s) that can be replaced by using the outputs of other cell(s)

reduce multiplexor trees

use fan-out from the cells, etc.

### Soft Drink Vending Machine Controller Design Example

The following example illustrates how the previously described features of the present invention are employed in the design of an application specific integrated circuit (ASIC). In this illustrative example the ASIC is designed for use as a vending machine controller. The vending machine controller receives a signal each time a coin has been deposited in a coin receiver. The coin value is recorded and when coins totalling the correct amount are received, the controller generates a signal to dispense a soft drink. When coins totalling more than the cost of the soft drink are received, the controller dispenses change in the correct amount.

This vending machine controller example is patterned after a textbook example used in teaching digital system controller design. See Fletcher, William I., *An Engineering Approach to Digital Design*, Prentice-Hall, Inc., pp. 491-505. Reference may be made to this textbook example for a more complete explanation of this vending machine controller requirements, and for an understanding and appreciation of the complex design procedures prior to the present invention for designing the hardware components for a controller.

FIG. 10 illustrates a flowchart for the vending machine controller system. This flowchart would be entered into the KBSC system by the user through the flowchart editor. Briefly reviewing the flowchart, the controller receives a coin present signal when a coin is received in the coin receiver. State0 and cond0 define a waiting state awaiting deposit of a coin. The symbol CP represents "coin present" and the symbol !CP repre-

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sents "coin not present". State1 and cond1 determine when the coin has cleared the coin receiver. At state20, after receipt of a coin, the macro instruction ADD3.1 (lc, cv, sum) instructs the system to add lc (last coin) and cv (coin value) and store the result as sum. The macro instruction associated with state21 moves the value in the register sum to cv. The macro CMP.1 at state22 compares the value of cv with PR (price of soft drink) and returns signals EQ, GT and LT. The condition cond2 tests the result of the compare operation 10 CMP.1. If the result is "not greater than" (!GT.CMP.1), then the condition cond3 tests to see whether the result is "equal" (EQ.CMP.1). If the result is "not equal" (!EQ.CMP.1), then control is returned to state0 awaiting the deposit of another coin. If cond3 is EQ, then 15 state4 generates a control signal to dispense a soft drink (droppop) and the macro instruction CLR.1(cv) resets cv to zero awaiting another customer.

If the total coins deposited exceed the price, then state30 produces the action "returncoin". Additionally, 20 the macro DECR.1 (cv) reduces the value of cv by the amount of the returned coin. At state31 cv and PR are again compared. If cv is still greater than PR, then control passes to state30 for return of another coin. The condition cond5 tests whether the result of CMP.2 is EQ and will result in either dispensing a drink (droppop) true or branching to state0 awaiting deposit of another coin. The macros associated with the states shown in FIG. 10 correspond to those defined in Table 1 above and define the particular actions which are to 30 be performed at the respective states.

Appendix A shows the intermediate file or "statelist" produced from the flowchart of FIG. 10. This statelist is produced as output from the EDSIM program 20 and is used as input to the PSCS program 30 (FIG. 3).

FIG. 11 illustrates for each of the macros used in the flowchart of FIG. 10, the corresponding hardware blocks. It will be seen that the comparison macro CMP (A,B) results in the generation of a register for storing value A, a register for storing value B, and a compar- 40 ator block and also produces control paths to the system controller for the EQ, LT, and GT signals generated as a result of the comparison operation. The addition macro ADD (A,B,C) results in the generation of a register for each of the input values A and B, a register for the output value C, and in the generation of an adder block. The macro DECR (A) results in the generation of a counter block. The PSCS program 30 maps each of the macros used in the flowchart of FIG. 10 to the corresponding hardware components results in the gener- 50 ation of the hardware blocks shown in FIG. 12. In generating the illustrated blocks, the PSCS program 30 relied upon rules 1 and 2 of the above listed example rules.

FIG. 13 illustrates the interconnection of the block of 55 FIG. 12 with data paths and control paths. Rule 3 was used by the data/control path synthesizer program 31 in mapping the data and control paths.

FIG. 14 shows the result of optimizing the circuit by applying rule 4 to eliminate redundant registers. As a 60 result of application of this rule, the registers R2, R3, R7, R8, and R9 in FIG. 13 were removed. FIG. 15 shows the block diagram after further optimization in which redundant comparators are consolidated. This optimization is achieved in the PSCS program 30 by 65 application of rule 5.

Having now defined the system controller block, the other necessary hardware blocks and the data and con-

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trol paths for the integrated circuit, the PSCS program 30 now generates a netlist 15 defining these hardware components and their interconnection requirements. From this netlist the mask data for producing the integrated circuit can be directly produced using available VLSI CAD tools.

```
name rpop;
data path @ic<0:5>, cv<0:5>, sum<0:5>, @pr<0:5>;
{
state4 : state0;
state30 : state31;
state21 : state22;
state20 : state21;
state0 : lcp state0;
state0 : cp state1;
state1 : cp state1;
state1 : lcp state20;
state22 : GT.CMP.1 state30;
state22 : !GT.CMP.1*EQ.CMP.1 state4;
state22 : !GT.CMP.1*EQ.CMP.1 state0;
state31 : GT.CMP.2 state30;
state31 : !GT.CMP.2*EQ.CMP.2 state4;
state31 : !GT.CMP.2*EQ.CMP.2 state0;
state30 : returncoin;
state30 : DECR.1(cv);
state4 : droppop;
state4 : CLR.1(cv);
state31 : CMP.2(cv,pr);
state22 : CMP.1(cv,pr);
state21 : MOVE.1(sum,cv);
state20 : ADD3.1(ic,cv,sum);
}
```

That which I claimed is:

1. A computer-aided design system for designing an application specific integrated circuit directly from architecture independent functional specifications for the integrated circuit, comprising

a macro library defining a set of architecture independent operations comprised of actions and conditions;

input specification means operable by a user for defining architecture independent functional specifications for the integrated circuit, said functional specifications being comprised of a series of operations comprised of actions and conditions, said input specification means including means to permit the user to specify for each operation a macro selected from said macro library;

a cell library defining a set of available integrated circuit hardware cells for performing the available operations defined in said macro library;

cell selection means for selecting from said cell library for each macro specified by said input specification means, appropriate hardware cells for performing the operation defined by the specified macro, said cell selection means comprising an expert system including a knowledge base containing rules for selecting hardware cells from said cell library and inference engine means for selecting appropriate hardware cells from said cell library in accordance with the rules of said knowledge base; and

netlist generator means cooperating with said cell selection means for generating as output from the system a netlist defining the hardware cells which are needed to achieve the functional requirements of the integrated circuit and the connections there-between.

2. The system as defined in claim 1 wherein said input means comprises means specification for receiving user

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input of a list defining the series of actions and conditions.

3. The system as defined in claim 1 additionally including mask data generator means for generating from said netlist the mask data required to produce an integrated circuit having the specified functional requirements.

4. The system as defined in claim 1 wherein said input means comprises flowchart editor means specification for creating a flowchart having elements representing said series of actions and conditions.

5. The system as defined in claim 4 additionally including flowchart simulator means for simulating the functions defined in the flowchart to enable the user to verify the operation of the integrated circuit.

6. The system as defined in claim 1 additionally including data path generator means cooperating with said cell selection means for generating data paths for the hardware cells selected by said cell selection means.

7. The system as defined in claim 6 wherein said data path generator means comprises a knowledge base containing rules for selecting data paths between hardware cells and inference engine means for selecting data paths between the hardware cells selected by said cell selection means in accordance with the rules of said knowledge base and the arguments of the specified macros.

8. The system as defined in claim 6 additionally including control generator means for generating a controller and control paths for the hardware cells selected by said cell selection means.

9. A computer-aided design system for designing an application specific integrated circuit directly from a flowchart defining architecture independent functional requirements of the integrated circuit comprising

a marco library defining a set of architecture independent operations comprised of actions and conditions;

flowchart editor means operable by a user for creating a flowchart having elements representing said architecture independent operations;

said flowchart editor means including macro specification means for permitting the user to specify for each operation represented in the flowchart a macro selected from said macro library;

a cell library defining a set of available integrated circuit hardware cells for performing the available operations defined in said macro library;

cell selection means for selecting from said cell library for each specified macro, appropriate hardware cells for performing the operation defined by the specified macro, said cell selection means comprising an expert system including a knowledge base containing rules for selecting hardware cells from said cell library and inference engine means for selecting appropriate hardware cells from said cell library in accordance with the rules of said knowledge base; and

data path generator means cooperating with said cell selection means for generating data paths for the hardware cells selected by said cell selector means, said data path generator means comprising a knowledge base containing rules for selecting data paths between hardware cells and inference engine means for selecting data paths between hardware cells selected by said cell selection means in accordance with the rules of said knowledge base and the arguments of the specified macros.

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10. The system as defined in claim 9 additionally including control generator means for generating a controller and control paths for the hardware cells selected by said cell selection means.

11. A computer-aided design system for designing an application specific integrated circuit directly from a flowchart defining architecture independent functional requirements of the integrated circuit, comprising

flowchart editor means operable by a user for creating a flowchart having boxes representing architecture independent actions, diamonds representing architecture independent conditions, and lines with arrows representing transitions between actions and condition and including means for specifying for each box or diamond, a particular action or condition to be performed;

a cell library defining a set of available integrated circuit hardware cells for performing actions and conditions;

a knowledge base containing rules for selecting hardware cells from said cell library and for generating data and control paths for hardware cells; and

expert system means operable with said knowledge base for translating the flowchart defined by said flowchart editor means into a netlist defining the necessary hardware cells and data and control paths required in an integrated circuit having the specified functional requirements.

12. The system as defined in claim 11 including mask data generator means for generating from said netlist the mask data required to produce an integrated circuit having the specified functional requirements.

13. A computer-aided design process for designing an application specific integrated circuit which will perform a desired function comprising

storing a set of definitions of architecture independent actions and conditions;

storing data describing a set of available integrated circuit hardware cells for performing the actions and conditions defined in the stored set;

storing in an expert system knowledge base a set of rules for selecting hardware cells to perform the actions and conditions;

describing for a proposed application specific integrated circuit a series of architecture independent actions and conditions;

specifying for each described action and condition of the series one of said stored definitions which corresponds to the desired action or condition to be performed; and

selecting from said stored data for each of the specified definitions a corresponding integrated circuit hardware cell for performing the desired function of the application specific integrated circuit, said step of selecting a hardware cell comprising applying to the specified definition of the action or condition to be performed, a set of cell selection rules stored in said expert system knowledge base and generating for the selected integrated circuit hardware cells, a netlist defining the hardware cells which are needed to perform the desired function of the integrated circuit and the interconnection requirements therefor.

14. A process as defined in claim 13, including generating from the netlist the mask data required to produce an integrated circuit having the desired function.

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15. A process as defined in claim 13 including the further step of generating data paths for the selected integrated circuit hardware cells.

16. A process as defined in claim 15 wherein said step of generating data paths comprises applying to the selected cells a set of data path rules stored in a knowledge base and generating the data paths therefrom. 5

17. A process as defined in claim 16 including the further step of generating control paths for the selected integrated circuit hardware cells. 10

18. A knowledge based design process for designing an application specific integrated circuit which will perform a desired function comprising

storing in a macro library a set of macros defining architecture independent actions and conditions; 15  
storing in a cell library a set of available integrated circuit hardware cells for performing the actions and conditions;

storing in a knowledge base set of rules for selecting hardware cells from said cell library to perform the actions and conditions defined by the stored macros; 20

describing for a proposed application specific integrated circuit a flowchart comprised of elements representing a series of architecture independent 25

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actions and conditions which carry out the function to be performed by the integrated circuit; specifying for each described action and condition of said series a macro selected from the macro library which corresponds to the action or condition; and applying rules of said knowledge base to the specified macros to select from said cell library the hardware cells required for performing the desired function of the application specific integrated circuit and generating for the selected integrated circuit hardware cells, a netlist defining the hardware cells which are needed to perform the desired function of the integrated circuit and the interconnection requirements therefor.

19. A process as defined in claim 18 also including the steps of

storing in said knowledge base a set of rules for creating data paths between hardware cells, and applying rules of said knowledge base to the specified means to create data paths for the selected hardware cells.

20. A process as defined in claim 19 also including the steps of generating a controller and generating control paths for the selected hardware cells.

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## **Exhibit 28**

**FILED**

APR 07 2005

RICHARD W. WIEKING  
CLERK, U.S. DISTRICT COURT  
NORTHERN DISTRICT OF CALIFORNIA

IN THE UNITED STATES DISTRICT COURT  
FOR THE NORTHERN DISTRICT OF CALIFORNIA

SYNOPSYS, INC.,

Plaintiff,

v.

RICOH CO., LTD.,

Defendant.

No. C 03-2289 MJJ  
No. C 03-4669

**CLAIM CONSTRUCTION ORDER**

RICOH CO., LTD.,

Plaintiff,

v.

AEROFLEX, INC., ET AL.,

Defendants.

**INTRODUCTION**

Before the Court is the parties' proposed construction of disputed terms contained in Plaintiff Ricoh Company, Ltd.'s ("Ricoh") patent. The suit involves an invention directed to a process for the design of application specific integrated circuits ("ASICs").

**FACTUAL BACKGROUND**

This case concerns the alleged infringement of U.S. Patent Number 4,922,432 (“the ‘432 patent”) entitled “Knowledge Based Method and Apparatus for Designing Integrated Circuits Using Functional Specifications.” The issue before the Court is the construction of ten disputed terms contained in the patent.

The ‘432 patent, owned by Ricoh, claims methods for using a CAD design system to design an ASIC. “An [ASIC] is an integrated circuit chip designed to perform a specific function, as distinguished from standard, general purpose integrated circuit chips, such as microprocessors, memory chips, etc.” ‘432 patent, col. 1:13-17. According to the ‘432 patent, the ASIC design processes of prior art require the designer to consider the required objectives and tasks of the desired ASIC and define the structural level design specification for that ASIC. This structural level design specification must define the various hardware components and their required interconnections, as well as a system controller for synchronizing the operations of those hardware components. This process requires an ASIC designer to have an “extensive and all encompassing knowledge” of these hardware components and their required interconnections. ‘432 patent, col. 1:28-31. There are only a small number of very large scale integration technology (VLSI) designers who possess the highly specialized skills needed to create structural level integrated circuit hardware descriptions.

The stated goal of the ‘432 patent’s claimed invention is to enable the non-expert designer to design ASICs. The ‘432 patent claims a method for enabling the use of higher level input descriptions by allowing designers to describe ASIC specifications at a functional level. This functional level description is done without specification of structure, implementing technology, or architecture. This process involves taking architecture independent specifications and selecting previously designed circuit components or structure used as building blocks for implementing an ASIC. The process selects the optimum hardware cells to be included in the desired ASIC. Following this method, a user who does not have expertise in VLSI design can write architecture independent ASIC descriptions that ultimately can result in the automatic selection of hardware cells to be used in the ASIC.

Claim 13 of the ‘432 Patent is at issue in this proceeding. Independent claim 13 describes a

1 process in which a designer describes an ASIC through an input specification using architecture  
2 independent descriptions. These architecture independent descriptions are used to select architecture  
3 dependent hardware cells. This process uses a library of definitions of the architecture independent,  
4 functional descriptions, a library of available hardware cells, and a expert system knowledge base.  
5 The expert system knowledge base contains a set of “rules” that embody the knowledge of VLSI  
6 experts. In order for each desired function to be performed by the ASIC, one of the definitions from  
7 the library of definitions is specified. The rules in the knowledge base are then applied to select  
8 architecture dependent hardware cells from the library of available hardware cells.

### 9 LEGAL STANDARD

10 The construction of a patent claim is a matter of law for the Court. *Markman v. Westview*  
11 *Instruments, Inc.*, 517 U.S. 370, 372 (1996). The Court must conduct an independent analysis of the  
12 disputed claim terms. It is insufficient for the Court to simply choose between the constructions  
13 proposed by the adversarial parties. *Exxon Chem. Patents v. Lubrizol Corp.*, 64 F.3d 1553, 1555  
14 (Fed. Cir. 1995). To determine the meaning of a patent claim, the Court considers three sources: the  
15 claims, the specification, and the prosecution history. *Markman v. Westview Instruments, Inc.*, 52  
16 F.3d 967, 979 (Fed. Cir. 1995) (*en banc*), *aff'd*, *Markman*, 517 U.S. 370.

17 The Court looks first to the words of the claims. *Vitronics Corp. v. Conception, Inc.*, 90  
18 F.3d 1576, 1582 (Fed. Cir. 1996). “Although words in a claim are generally given their ordinary and  
19 customary meaning, a patentee may choose to be his own lexicographer and use terms in a manner  
20 other than their ordinary meaning, as long as the special definition of the term is clearly stated in the  
21 patent specification or file history.” *Id.* (citation omitted). “A technical term used in a patent  
22 document is interpreted as having the meaning that it would be given by persons experienced in the  
23 field of the invention, unless it is apparent from the patent and the prosecution history that the  
24 inventor used the term with a different meaning.” *Hoechst Celanese Corp. v. BP Chems. Ltd.*, 78  
25 F.3d 1575, 1578 (Fed. Cir. 1996). The doctrine of claim differentiation creates the presumption that  
26 limitations stated in dependent claims are not to be read into the independent claim from which they  
27 depend because different language used in separate claims is presumed to indicate that the claims  
28 have different meanings and scope. *Tandon Corp. v. U.S. International Trade Com.*, 831 F.2d 1017,

1 1023 (Fed. Cir. 1987).

2 Second, it is always necessary to review the specification to determine whether the inventor  
3 has used any terms in a manner inconsistent with their ordinary meaning. *Vitronics*, 90 F.3d at 1582.  
4 The specification can act as a dictionary when it expressly or impliedly defines terms used in the  
5 claims. *Id.* Because the specification must contain a description of the invention that is clear and  
6 complete enough to enable those of ordinary skill in the art to make and use it, the specification is  
7 the single best guide to the meaning of a disputed term. *Id.* The written description part of the  
8 specification itself does not delimit the right to exclude, however; that is the function and purpose of  
9 claims. *Markman*, 52 F.3d at 980.

10 Third, the court may consider the prosecution history. *Vitronics*, 90 F.3d at 1582. “Although  
11 the prosecution history can and should be used to understand the language used in the claims, it too  
12 cannot enlarge, diminish, or vary the limitations in the claims.” *Markman*, 52 F.3d at 980 (internal  
13 quotation marks deleted) (citations omitted). However, a concession made or position taken to  
14 establish patentability in view of prior art on which the examiner has relied, is a substantive position  
15 on the technology for which a patent is sought, and will generally generate an estoppel. In contrast,  
16 when claim changes or arguments are made in order to more particularly point out the applicant’s  
17 invention, the purpose is to impart precision, not to overcome prior art. Such prosecution is not  
18 presumed to raise an estoppel, but is reviewed on its facts, with the guidance of precedent. *Pall*  
19 *Corp. v. Micron Separations, Inc.*, 66 F.3d 1211, 1220 (Fed. Cir. 1995) (citations omitted).

20 Ordinarily, the Court should not rely on expert testimony to assist in claim construction,  
21 because the public is entitled to rely on the public record of the patentee’s claim (as contained in the  
22 patent claim, the specification, and the prosecution history) to ascertain the scope of the claimed  
23 invention. *Vitronics*, 90 F.3d at 1583. “[W]here the public record unambiguously describes the  
24 scope of the patented invention, reliance on any extrinsic evidence is improper.” *Id.* Extrinsic  
25 evidence should be used only if needed to assist in determining the meaning or scope of technical  
26 terms in the claims, and may not be used to vary or contradict the terms of the claims. *Id.* (quoting  
27 *Pall Corp.*, 66 F.3d at 1216); *Markman*, 52 F.3d at 981.

28 The Court is free to consult technical treatises and dictionaries at any time, however, in order

to better understand the underlying technology and may also rely on dictionary definitions when construing claim terms, so long as the dictionary definition does not contradict any definition found in or ascertained by a reading of the patent documents. *Vitronics*, 90 F.3d at 1584 n.6. The Court also has the discretion to admit and rely upon prior art proffered by one of the parties, whether or not cited in the specification or the file history, but only when the meaning of the disputed terms cannot be ascertained from a careful reading of the public record. *Id.* at 1584. Referring to prior art may make it unnecessary to rely on expert testimony, because prior art may be indicative of what all those skilled in the art generally believe a certain term means. *Id.* Unlike expert testimony, these sources are accessible to the public prior to litigation to aid in determining the scope of an invention. *Id.*

Disputed claim terms are construed consistently across all claims within a patent. *Southwall Techs., Inc. v. Cardinal IG Co.*, 54 F.3d 1570, 1579 (Fed. Cir. 1995). Where patents-in-suit share the same disclosures, common terms are construed consistently across all claims in both patents. *Mycogen Plant Sci., Inc. v. Monsanto Co.*, 252 F.3d 1306, 1311 (Fed. Cir. 2001) (*overruled on other grounds*).

“The subjective intent of the inventor when he used a particular term is of little or no probative weight in determining the scope of a claim (except as documented in the prosecution history).” *Markman*, 50 F.3d at 985 (citation omitted). “Rather the focus is on the objective test of what one of ordinary skill in the art at the time of the invention would have understood the term to mean.” *Id.* at 986.

#### DISPUTED CLAIM TERMS

The following is a list of ten terms identified by the parties in the October 21, 2004 Joint Submission of Terms, Phrases, and Clauses for Claims Construction:

- 1) **A computer-aided design process for designing**
- 2) **architecture independent actions and conditions**
- 3) **a set of definitions of architecture independent actions and conditions**
- 4) **describing . . . a series of architecture independent actions and conditions**
- 5) **expert system knowledge base**
- 6) **a set of cell selection rules**

- 7) selecting from said stored data for each of the specified definitions a corresponding integrated circuit hardware cell
- 8) said step of selecting a hardware cell comprising applying to the specified definition of the action or condition to be performed
- 9) specifying for each described action and condition of the series one of said stored definitions
- 10) a netlist defining the hardware cells which are needed to perform the desired function of the integrated circuit

## ANALYSIS

### A. *A computer-aided design process for designing*

Ricoh contends that the term means “during manufacture of a desired application specific integrated circuit (ASIC) chip . . . a process of designing the desired ASIC using a computer.” Aeroflex Inc. and Synopsys, Inc. (“Aeroflex”) state that the term means “a process that uses a computer for designing, as distinguished from a computer-aided manufacturing process, which uses a computer to direct and control the manufacturing process.” In essence, the parties’ fundamental disagreement revolves around whether the computer-aided design process described in claim 13 also encompasses the ASIC manufacturing process.

Ricoh bases its proposed construction on the text of the patent specification. Specifically, Ricoh directs the Court to language in the specification that states that “the present invention, for the first time, opens the possibility for *the design and production* of ASICs by designers, engineers and technicians who may not possess the specialized expert knowledge of a highly skilled VLSI design engineer.” ‘432 patent, col. 2:15-20 (emphasis added). Ricoh also emphasizes that the present invention produces a “physical chip layout level description [that] provides the mask data needed for fabricating the chip.” ‘432 patent, col. 1:42-44; *see also* ‘432 patent, col. 3:68 - 4:4 (“FIG. 1c illustrates a physical layout level representation of an integrated circuit design, which provides the detailed mask data necessary to actually manufacture the devices and conductors which together comprise integrated circuit.”).

Aeroflex argues that Ricoh’s proposed construction is contrary to the ‘432 patent’s claims

1 and specifications.<sup>1</sup> Specifically, Aeroflex focuses on the claim language that provides that the  
 2 invention is a “computer-aided design process for designing . . .” ‘432 patent, col. 16:34. Aeroflex  
 3 also directs the Court to specification language that states the invention “relates to the design of  
 4 integrated circuits, and more particularly relates to a computer-aided method . . . for designing  
 5 integrated circuits.”<sup>2</sup> ‘432 patent, col. 1:9-12.

6 Ricoh’s proposed definition is problematic because it clearly attempts to blur the line  
 7 between the process of designing integrated circuits and the process of manufacturing integrated  
 8 circuits. Nothing in the claim language supports Ricoh’s attempt to broaden the claims to include a  
 9 manufacturing process for a desired ASIC. Rather, the claim language describes a “computer-aided  
 10 design process for designing an [ASIC] . . .” ‘432 patent, col. 16:34-35. Likewise, the specification  
 11 consistently describes a design, rather than a manufacturing, process. In fact, the term “manufacture”  
 12 does not appear in the claim or specification language.<sup>3</sup> While the “netlist” may be required to  
 13 “produce the particular [ASIC],” *see* ‘432 patent, col. 2:44-49, that does not compel the conclusion  
 14 that the ‘432 patent’s design process is inherently a part of the manufacturing process of the actual  
 15 ASIC chips. Given the Court’s “focus . . . on the objective test of what one of ordinary skill in the  
 16 art at the time of the invention would have understood the term to mean,” *Markman*, 50 F.3d at 985,  
 17 the Court finds that the “computer-aided design process” described in claim 13 does not include a  
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20  
 21 <sup>1</sup>Aeroflex also argues that Ricoh’s proposed construction is contrary to statements made in the  
 22 ‘432 patent’s file history. Specifically, the April 1989 Amendment provides: “The present invention is  
 a computer-aided design . . . method whereby the use can design application specific integrated circuits  
 . . .” (April 1989 Amendment at 8).

23 <sup>2</sup>Aeroflex also argues that its proposed construction is more consistent with the ‘432 patent’s  
 24 title: “Knowledge Based Method and Apparatus For *Designing* Integrated Circuits Using Functional  
 Specifications” (emphasis added).

25 <sup>3</sup>In its reply, Ricoh focuses solely on the specification language that states “the present invention,  
 26 for the first time, opens the possibility for the design *and production* of ASICs by designers, engineers  
 27 and technicians who may not possess the specialized expert knowledge of a highly skilled VLSI design  
 28 engineer.” ‘432 patent, col. 2:15-20 (emphasis added). However, this language, standing alone, does  
 little to persuade the Court that the present invention was intended to encompass the ASIC  
 manufacturing process. Rather, a fair reading of this language is that the present invention simply  
 opened up the “possibility” that non-experts could produce or manufacture ASICs at some point in the  
 future, but not that the present invention currently encompassed such a process.

1 manufacturing process for ASICs.<sup>4</sup>

2 Given these considerations, the clearest reading of “A computer-aided design process for  
3 designing” is *a process that uses a computer to direct and control the design of an ASIC chip.*

4 **B. *architecture independent actions and conditions***

5 Ricoh contends that the term means “functional or behavioral aspects of a portion of a circuit  
6 (or circuit segment) that does not imply any set architecture, structure or implementing technology.”  
7 Aeroflex states that the term means “the logical steps and decisions that are represented as rectangles  
8 and diamonds in the flowchart; where register-transfer level (RTL, as defined in Darringer et al.)  
9 descriptions are excluded.” Thus, the parties disagreement focuses on whether claim 13 limits input  
10 specifications for the proposed ASIC to data in a flowchart format.

11 Ricoh admits that Fig. 1a illustrates an embodiment that utilizes a flowchart representation.  
12 However, Ricoh argues that Aeroflex’s definition impermissibly attempts to limit the scope of the  
13 claimed invention to the preferred embodiment of the ‘432 patent. Ricoh contends that a broader  
14 interpretation of “architecture independent actions and conditions” is supported by the patent  
15 specification:

16 The architecture independent functional specifications can be defined in a suitable  
17 manner, *such as in list form* or preferably in a flowchart form. The flowchart is a  
18 highly effective means of describing a sequence of logical operations, and is well  
19 understood by software and hardware designers of varying levels of expertise and  
20 training. From the flowchart (*or other functional specifications*), the system and  
method of the present invention translates the architecture independent functional  
specifications into an architecture specific structural level definition of an  
integrated circuit, which can be used directly to produce the ASIC.

21 ‘432 patent, col. 2:21-34 (emphasis added).<sup>5</sup> Ricoh also relies on specification language stating that  
22 “the present invention . . . enables a user to define the functional requirements for a desired target  
23 integrated circuit, using an easily understood architecture independent functional level representation  
24 . . . .” ‘432 patent, col. 2:6-11. Ricoh also notes that patent claim 11, not patent claim 13,

25 “This conclusion is also bolstered by the language in claim 14. Claim 14 describes “[a] process  
26 as defined in claim 13, including generating from the netlist the mask data required to produce an  
27 integrated circuit having the desired function.” ‘432 patent, col. 16:66-68. This language clarifies that  
the generation of the netlist (the final step in claim 13) and the production of the integrated circuit are  
two distinct processes.

28 “Rico argues that a “list form” input specification is a preferred embodiment of the ‘432 patent.  
However, this argument does not find any support in the patent specification.

specifically references a flowchart format and recites “having boxes representing architecture independent actions” and “diamonds representing architecture independent conditions.” ‘432 patent, col. 16:10-12. Ricoh argues that this demonstrates that if the patentee intended the use of “architecture independent” in claim 13 to be restricted to a flowchart format, the patentee would have used the same or similar limiting language as used in claim 11.

Aeroflex responds that the ‘432 patent’s file history conclusively demonstrates that claim 13 requires a sequence of logical steps and decisions in a flowchart format.<sup>6</sup> See April 1989 Amendment at 11; October 1989 Examiner Interview Summary; November 1989 Amendment at 7. Aeroflex contends that the Examiner Interview Summary explicitly states that the examiner and the applicant reached an agreement on application term 20 (patent claim 13). Specifically, the Examiner Interview Summary form shows that the examiner checked the box providing: “Agreement was reached with respect to some or all of the claims in question.” (October 1989 Interview Summary). The summary form identifies application claim 20 (patent claim 13) as one of the claims discussed, and states that the following agreement was reached: “It is agreed that the features ‘flowchart editor’ and ‘expert system for translating the flowchart into a netlist defining the necessary hardware cells of the integrated circuit’ are patentable [sic] distinct from the reference list above.” Aeroflex argues that this language demonstrates that an agreement was reached and that the features “flowchart editor” and “expert system for translating the flowchart into a netlist” were the examiner’s only basis for allowing all of the claims including patent claim 13. Furthermore, Aeroflex contends that the file history demonstrates that all register-transfer level descriptions were explicitly excluded from the claimed invention.

Ricoh responds that the October Interview summary, at best, is ambiguous and inconclusive. Ricoh states that while the Interview summary clearly identified the claims discussed in the interview, it specifically left undefined which claims were subject to any agreement reached because the form indicated that an agreement was reached as “to some or all of the claims.” Thus, Ricoh

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<sup>6</sup>Aeroflex’s reliance on the specification language to support its argument is not well taken. Aeroflex cites almost exclusively to language from the preferred embodiment. See ‘432 patent, col. 3:50-59; 4:5-22, 4:35-38, 7:12-23. However, in construing disputed claim terms, a limitation cannot be imported from the preferred embodiment into the claims themselves. *Markman*, 52 F.3d at 980.

1 concludes that the only thing evidently agreed upon was that the features of a “flowchart editor” and  
2 an “expert system” were distinct over prior art, and any claims containing those features would be  
3 understood by both parties to be patentable over the cited prior art. Ricoh contends that this  
4 understanding is supported in the November 1989 Amendment, in which the patentee stated as  
5 follows:

6 During the interview, the Examiner carefully reconsidered the prior art and  
7 applicants’ claims, and upon reconsideration agreed that certain features as  
8 defined in applicants’ claims, such as the “flowchart editor” and the “expert  
9 system for translating the flowchart into a netlist defining the necessary hardware  
10 cells of the integrated circuit” patentably distinguish applicants’ invention from  
the prior art of record, including Darringer et al. 4,703,435. Thus, it was agreed  
that Claim 18 [patent claim 11] in its present form, for example, patentably defines  
applicants’ invention over the prior art of record.

11 November 1989 Amendment at 7. Ricoh argues that the patentee could have made a similar  
12 statement with respect to application claim 20 (patent claim 13). Furthermore, Ricoh argues that  
13 Aeroflex’s attempt to exclude register-level transfer descriptions from the claimed invention  
14 improperly distorts the file history.

15 Initially, the Court finds that the specification language supports Ricoh’s arguments. While  
16 the flowchart format input specification is the single embodiment of the ‘432 patent, the  
17 specification explicitly contemplated alternative input descriptions. *See* ‘432 patent, col. 2:21-24;  
18 2:27-28. “[I]t is improper to read limitations from a preferred embodiment described in the  
19 specification – even if it is the only embodiment – into the claims absent a clear indication in the  
20 intrinsic record that the patentee intended the claims to be so limited.” *Liebel-Flarshiem Co. v.*  
21 *Medrad, Inc.*, 358 F.3d 898, 913 (Fed. Cir. 2004). Given the explicit patent language, the Court  
22 finds that the specification language does not support the conclusion that the input specification of  
23 the claimed invention is limited to a flowchart format.

24 Furthermore, the Court is not persuaded that the prosecution history unmistakably  
25 demonstrates that the input specification of the claimed invention is limited to the designer’s use of a  
26 flowchart format. As noted by Ricoh, the October Interview Summary specifically left undefined  
27 which claims were subject to any agreement between the patentee and the examiner. Thus, contrary  
28 to Aeroflex’s

1 argument, this case is distinguishable from cases such as *Spring Window Fashions LP v. Novo*  
2 *Industries, L.P.*, 323 F.3d 989 (Fed Cir. 2003), in which the court held that a reasonable competitor  
3 could rely on unequivocal statements of disclaimer made during the prosecution history. Here, the  
4 statements made during the prosecution history upon which Aeroflex attempts to rely, are at best,  
5 ambiguous.

6 In addition, while the patentee and the examiner evidently agreed that the features of a  
7 “flowchart editor” and an “expert system” were distinct over prior art, there is no indication that  
8 those terms necessarily applied to application term 20 (patent claim 13). Moreover, the fact that  
9 those terms were not included in the final version of patent claim 13 suggests just the opposite. “To  
10 be given effect, a disclaimer must be ‘clear and unmistakable.’” *Sunrace Roots Enter. Co. v. SRAM*  
11 *Corp.*, 336 F.3d 1298, 1306 (Fed. Cir. 2003) (quoting *Omega Eng’g, Inc. v. Raytek Corp.*, 334 F.3d  
12 1314, 1325 (Fed. Cir. 2003)). While Aeroflex’s interpretation of the October Interview summary  
13 may be reasonable, the law requires much more. Accordingly, “because the statements in the  
14 prosecution history are subject to multiple reasonable interpretations, they do not constitute a clear  
15 and unmistakable departure from the ordinary meaning of the [claim term at issue].” *Golight, Inc. v.*  
16 *Wal-Mart Stores, Inc.*, 355 F.3d 1327, 1332 (Fed. Cir. 2004).

17 Aeroflex’s argument pertaining to the file history of register-transfer level descriptions is  
18 more persuasive. The file history demonstrates that the patentee amended the patent claims to  
19 include the phrase “architecture independent,” and distinguished the claimed invention from prior art  
20 partially on that basis. See November 1989 Amendment at 7. The patentee stated that the  
21 “specifications used by Darringer et al. are not truly at an architecture independent level, but rather  
22 are at a lower level which is indeed hardware architecture dependent and defines the system at a  
23 ‘register-transfer’ level description.” *Id.* Similarly, in the April 1989 Amendment, the patentee  
24 stated that “a very clear distinction between Darringer and the present invention is that the input to  
25 the Darringer system is in the form of a register transfer level flowchart control language . . . [and]  
26 input to the present invention is in the form of an architecture independent functional specification.”  
27 *Id.* Based on this language, Aeroflex argues that Ricoh disclaimed the “register-transfer” level  
28 descriptions described in the Darringer prior art from the scope of its claimed invention. Ricoh

1 responds that the patentee's use of the term "register-transfer level" was merely a shorthand  
2 reference used to denote the "structural" RTL-type, as opposed to "functional" RTL-type, of input  
3 systems prevalent at the time.

4 In order to make this determination, the Court must examine the Darringer 4,704,435 Patent  
5 ("the '435 patent") and how closely it reads upon the present invention. The '435 patent specifically  
6 defines a register-transfer level description and the subsequent translation or transformation steps  
7 described in that patent do not alter this explicit definition.<sup>7</sup> '435 patent, col. 5:27-38. The Court  
8 finds no relevant distinction between the RTL described in the '435 patent and the RTL specifically  
9 disclaimed by Ricoh in the April and November 1989 Amendments. Furthermore, an examination of  
10 the '432 patent's public record fails to provide any support for Ricoh's distinction between  
11 "structural" and "functional" RTL-type input systems. Given these findings, Ricoh's attempt to limit  
12 the patentee's disclaimer to only "structural" level RTL-type input systems is unpersuasive. *See*  
13 *Kumar v. Ovonic Battery Co., Inc.*, 351 F.3d 1364, 1368 (Fed. Cir. 2003) (adopting definition of  
14 term in cited prior art which is intrinsic evidence). Accordingly, the prosecution history indicates  
15 that the patentee expressly disclaimed all register-transfer level descriptions.

16 Given these considerations, the Court defines "architecture independent actions and  
17 conditions" as *functional or behavioral aspects of a portion of a circuit (or circuit segment) that*  
18 *does not imply a set architecture, structure, or implementing technology, but excludes the use of*  
19 *register-transfer level descriptions as taught in Darringer.*

20 **C. *a set of definitions of architecture independent actions and conditions***

21 Ricoh contends that the term means "a library of definitions of the different architecture  
22 independent actions and conditions that can be selected for use in the desired ASIC." In contrast,  
23 Aeroflex proposes that the term means "a set of named descriptions defining the functionality and  
24 arguments for the available logical steps and decisions that may be specified in the flowchart where

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25  
26 <sup>7</sup>[T]he process of this invention begins at step 100 with a register-transfer level description e.g.  
27 of the type shown in Fig. 4. The description consists of two parts: a specification of the inputs, outputs  
28 and latches of the chip to be synthesized; and a flowchart-like specification of control, describing for a  
single clock cycle of the machine how the chip outputs and latches are set according to the values of the  
chip inputs and previous values of the latches. At step 102 in FIG 2., the register-transfer level  
description undergoes a simple translation to an initial implementation of AND/OR logic. '435 patent,  
col. 5:27-38.

1 register-transfer level (RTL, as defined in Darringer et al.) descriptions are excluded.”

2 It appears that the parties real dispute centers, once again, around the term “architecture  
3 independent actions and conditions.” This phrase should be construed as explained *supra*. It does  
4 not appear that the Court needs to construe “a set of definitions,” as this term should be given its  
5 ordinary and customary meaning. To the extent that “a set of definitions” needs to be construed by  
6 the Court, Aeroflex’s Responsive Brief is unhelpful because it never addresses Ricoh’s proposed  
7 construction. It appears that Aeroflex’s use of the terms “named descriptions” and “arguments”  
8 intends to encompass the “macros” shown in Table 1 of the ‘432 patent. *See* ‘432 patent, col. 7:29-  
9 49. Given Aeroflex’s lack of analysis of this term, the Court cannot accept Aeroflex’s definition as it  
10 has not presented a basis for narrowing the claim term. Ricoh’s use of the term “library” is  
11 supported by the patent’s intrinsic evidence. *See* ‘432 patent, col. 2:20-22. Thus, the Court  
12 construes “a set of definitions of architecture independent actions and conditions” as *a library of*  
13 *definitions of the different architecture independent actions and conditions that can be selected for*  
14 *use in the desired ASIC.*

15 **D. describing . . . a series of architecture independent actions and conditions**

16 Ricoh contends that the term means “a user describing an input specification containing the  
17 desired functions to be performed by the desired ASIC.” Aeroflex states that the term means “the  
18 designer represents a sequence of logical steps (rectangles) and decisions (diamonds), and the  
19 transitions (lines with arrows) between them in a flowchart format that excludes any register-transfer  
20 level (RTL, as defined in Darringer et al.) descriptions.

21 Once again, it appears that the parties real dispute centers around the term “architecture  
22 independent actions and conditions.” This phrase should be construed as explained *supra* and is not  
23 limited to the use of a “flowchart format.” To the extent that the terms “describing” and “series”  
24 need to be defined, they should be given their ordinary and customary meaning. “Describe” is  
25 defined as “to represent or give an account in words.” Merriam-Webster’s Ninth New Collegiate  
26 Dictionary (1987). The parties have not provided the Court with the ordinary meaning of the term  
27 “series.”

28 Aeroflex argues that Ricoh’s proposed construction is contrary to the claim language because

1 it merely requires an input specification “containing the desired functions,” and thus eliminates the  
2 requirement that the designer must describe “a series.” Aeroflex contends that such a definition  
3 contradicts the actual words in the claim (i.e., “describing . . . a series) and is also contrary to the  
4 requirement in the patent’s specification that the designer must “describ[e] a sequence of logical  
5 operations.” ‘432 patent, col. 2:24-25. Ricoh does not address this argument. Accordingly, the  
6 Court defines “describing . . . a series of architecture independent actions and conditions” as  
7 *describing an input specification containing a series of desired functions to be performed by the*  
8 *desired ASIC.*

9 **E. expert system knowledge base**

10 Ricoh contends that the term means “a database used to store expert knowledge of highly  
11 skilled VLSI designers.” Aeroflex defines “expert system” and “knowledge base” separately.  
12 Aeroflex states that “expert system” should be defined as “software that solves problems through  
13 selective application of the rules in the knowledge base by an inference engine, as distinguished from  
14 conventional software, which uses a predefined step-by-step procedure (algorithm) to solve  
15 problems.” Aeroflex asserts that a knowledge base is a “portion of the expert system software  
16 having a set of rules, each rule having an antecedent portion (e.g. IF) and a consequent portion (e.g.,  
17 THEN), and embodying the knowledge of expert designers for application specific integrated  
18 circuits.”

19 Ricoh’s proposed construction relies heavily on the ‘432 patent’s specification. Specifically,  
20 the specification states that “[t]he knowledge base 35 contains ASIC design expert knowledge  
21 required for data path synthesis and cell selection.” ‘432 patent, col. 5:6-8. “Using a rule based  
22 expert system with a knowledge base 35 extracted from expert ASIC designers, the KBSC system  
23 selects from the cell library 34 the optimum cell for carrying out the desired function.” ‘432 patent,  
24 col. 5:25-29. Based on these passages, Ricoh argues that an “expert system knowledge base” is a  
25 collection of data that represents knowledge obtained from experts in ASIC design.

26 Aeroflex dismisses Ricoh’s proposed construction as overly simplistic. Aeroflex argues that  
27 a person of ordinary skill in the art in 1988 would have known that two distinct approaches existed  
28 for selecting hardware cells: 1) rule-based expert system software; and 2) conventional algorithmic

1 software. Aeroflex further contends that a person of ordinary skill in the art would have understood  
2 that rule-based expert system software must contain an inference engine, a knowledge base, and a  
3 working memory, which enable the inference engine to selectively apply the rules stored in the  
4 knowledge base to what is stored in the working memory (as distinguished from conventional  
5 algorithmic software, which uses a predefined step-by-step procedure). To support its argument,  
6 Aeroflex cites to a technical dictionary entitled “Artificial Intelligence Terminology” that states: “An  
7 expert system will generally consist of a rule base, an inference engine and a user interface (which  
8 will generally provide an explanation facility).” Aeroflex also cites the Court to the Dunn Patent  
9 4,656,603 (“the ‘603 patent”). The ‘603 patent speaks in general terms regarding the distinction  
10 between the two types of software and states that since rule-based expert systems “often must make  
11 conclusions based on incomplete or uncertain information, they differ substantially from  
12 conventional computer programs which solve problems in accordance with pre-defined algorithms  
13 and complete data sets.” ‘603 patent, col. 1:44-49.

14 Aeroflex also argues that the distinction between the rule-based expert system approach and  
15 the conventional algorithmic approach is evident from the prior art that the patentee distinguished in  
16 the patent’s file history. In the November 1989 Amendment, the patentee added the following  
17 language to application claim 5 (patent claim 1): “said cell selection means comprising an expert  
18 system including a knowledge base containing rules for selecting hardware cells from said cell  
19 library and inference engine means for selecting appropriate hardware cells from said cell library in  
20 accordance with the rules of said knowledge base.” November 1989 Amendment at 2. The patentee  
21 stated that application claim 5 (patent claim 1) was amended to “clearly distinguish it over the cited  
22 prior art by more clearly defining the expert system aspects of applicant’s invention including the  
23 provision of a knowledge base containing rules for selecting hardware cells, inference engine means  
24 for selecting appropriate hardware cells, and netlist generator means for generating a netlist defining  
25 the hardware . . . .” November 1989 Amendment at 8. Although this amendment applied only to  
26 application claim 5 (patent claim 1), the patentee also amended application claim 20 (patent claim  
27 13) to include “applying . . . a set of cell selection rules stored in said expert system knowledge base .  
28 . . .” The patentee explained that this language was added to “emphasize the expert system aspects

1 of applicants' method." November 1989 Amendment at 9. Thus, Aeroflex is essentially arguing that  
2 the description of an expert system in patent claim 1 (including an inference engine) should also be  
3 read to encompass the expert system described in patent claim 13.

4 Ricoh responds that the patentee's statement in the November 1989 Amendment only further  
5 proves its point. Ricoh argues that this statement does not establish that an "expert system" had  
6 become an element of claim 13, but merely confirmed the patentee intent to claim certain aspects  
7 (i.e., the claimed "expert system knowledge base") of an expert system - not an expert system itself.<sup>8</sup>  
8 Moreover, Ricoh argues that even if the Court finds that the patentee intended to encompass both an  
9 "expert system" and a "knowledge base," there is nothing in the claim language, specification, or  
10 prosecution history that requires that an expert system contain an inference engine and a working  
11 memory.

12 Initially, the Court finds no support for Ricoh's argument that "expert system" is simply an  
13 adjective modifying the noun "knowledge base." The patentee explicitly stated that claim 13 was  
14 "amended to emphasize the expert system aspects of applicant's method." November 1989  
15 Amendment at 9. Therefore, the Court finds that "expert system" was an element of claim 13.

16 Next, the Court finds that Aeroflex's assertion that a person of ordinary skill in the art would  
17 have understood that rule-based expert system software must contain an inference engine, a  
18 knowledge base, and a working memory is simply not supported by the intrinsic evidence. As noted  
19 by Ricoh, claims one through nine of the '432 patent specifically claim an inference engine, while  
20 claim 13 does not make such a claim. Aeroflex's attempt to have the Court read the description of  
21 an expert system from patent claim 1 onto the expert system described in patent claim 13 is  
22 unpersuasive. Additionally, the technical dictionary definition provided by Aeroflex states that an  
23 inference engine is "generally" an element of an expert system. Given the qualified language of the  
24 definition, in combination with the fact that claim 13 makes no mention of an "inference engine," the  
25 Court finds the technical dictionary definition unhelpful in this context. Finally, Aeroflex's  
26 reference to the '603 patent is ultimately unhelpful, as the '603 patent describes an intentional expert  
27

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28 <sup>8</sup>In other words, Ricoh is arguing that the term "expert system" is grammatically read as an adjective or other modifier for the noun "knowledge base."

1 system, as opposed to a knowledge-based expert system, and makes no mention of an inference  
2 engine. '603 patent, col. 5:53-56. Given these considerations, the Court defines "expert system" and  
3 "knowledge base" separately. "Expert system" should be defined as *software that solves problems*  
4 *through selective application of rules in the knowledge base*. "Knowledge base" should be defined  
5 as a *portion of an expert system software having a set of rules and embodying expert knowledge of*  
6 *highly skilled VLSI designers*.

7 **F. a set of cell selection rules**

8 Ricoh contends that the disputed term is defined as "a plurality of rules for selecting among  
9 the hardware cells from the hardware cell library, wherein the rules comprise the expert knowledge  
10 of highly skilled designers formulated as prescribed procedures." Aeroflex contends that the term is  
11 properly defined as "a set of rules embodying the knowledge of expert designers for application  
12 specific integrated circuits, each rule having an antecedent portion (e.g. IF) and a consequent portion  
13 (e.g., THEN), which enables the expert system to map the specified stored definitions for each  
14 logical step and decision represented in the flowchart to a corresponding stored hardware cell  
15 description."

16 Aeroflex states that its proposed construction is consistent with contemporaneous technical  
17 dictionaries, treatises, and the prior art. *See* Ex. 15 at 74-75, Ex. 17 at 10-11, Ex. 14 at 10, 53, Ex.  
18 18 at 8, Ex. 20 at 14-15, Ex. 21 at 269. "The two parts of a rule are a premise and a conclusion, a  
19 situation and an action, or an antecedent and a consequent. These statements are written in an IF-  
20 THEN format." Ex. 15 at 74, Louis E. Frenzel Jr., *Understanding Expert Systems*. The technical  
21 dictionary provided by Aeroflex defines "rule" as follows: "(If-Then Rule). A conditional statement  
22 of two parts." Ex. 21, Paul Harmon, *Expert Systems: Tools & Applications*. Aeroflex also argues  
23 that the patent's specification requires that the "rules" not only embody expert knowledge, but that  
24 the expert knowledge also be used for mapping the specified definitions in the flowchart to the  
25 hardware cell descriptions. Aeroflex Responsive Brief at 48; *see* '432 patent, col. 8:21-23; 8:34-37.

26 Ricoh contends that the general usage dictionary definition of "rule" should apply. Also,  
27 while Ricoh admits that the preferred embodiment of the '432 patent disclosed that "rules" could be  
28 in the format of "an antecedent portion (IF) and a consequent portion (THEN)," it also asserts that

nothing in the public record justifies restriction of the claimed “rules” to the exemplary format disclosed as the preferred embodiment. Ricoh additionally contends that the ‘432 patent states specific rules in the specification that are not stated in the if/then format. *See* ‘432 patent, col. 12:31-35. Moreover, Ricoh also disagrees with Aeroflex’s inclusion of the following requirement: “embodying the knowledge of expert designers for application specific circuits.” Ricoh argues that to the extent Aeroflex is attempting to create a distinction between the knowledge of designers for ASICs and the knowledge of designers skilled in VLSI design, the claim should be construed broadly to include either skill. *See, e.g.*, ‘432 patent, col. 2:58-61 (“The KBSC utilizes a knowledge based expert system, with a knowledge base extracted from expert ASIC designers with a high level of expertise in VLSI design . . .”); col. 4:8-11 (“In the KBSC system of the present invention, however, integrated circuits can be designed at a functional level because the expertise in VLSI design is provided and applied by the invention.”)

Based on Aeroflex’s citation to the technical dictionary, it appears that “rule” as used in the ‘432 patent would have had a particular meaning to one of ordinary skill in the art. Therefore, to the extent Ricoh’s definition relies on a general dictionary definition, it must be rejected. *See Vanderlande Industries Nederland BV v. I.T.C.*, 366 F.3d 1311, 1321 (Fed. Cir. 2004). The technical dictionary definition offered by Aeroflex demonstrates that the ordinary meaning of “rules” when used to refer to rules that are contained in the knowledge base of a rule-based expert system must include an “IF-THEN” component. The Court is not persuaded that column 12, lines 31 to 35 of the ‘432 patent state “rules” as that term is understood in the patent. Rather, lines 31 to 35 appear to be discussing other actions that a user could take if additional rules were present.

However, the Court finds little support for Aeroflex’s argument that claim 13 requires that the rules stored in the knowledge base of the rule-based expert system embody the expert knowledge for mapping the specified definitions in the flowchart to the hardware cell descriptions. Certainly, the plain language of claim 13 does not dictate that the “rules” encompass the “mapping” function. Moreover, while the patent’s specification does suggest that the rules might play such a role in the preferred embodiment, *see* ‘432 patent, col. 8:34-37, such a conclusion is not compelled from the specification language. In any event, the Court should not “limit[] the claimed invention to preferred

embodiments or specific examples in the specification.” *Ekchian v. Home Depot, Inc.*, 104 F.3d 1299, 1303 (Fed. Cir. 1997).

Furthermore, Ricoh correctly states that the definition should not make a distinction between the knowledge of designers for ASICs and the knowledge of designers skilled in VLSI design. The specification clearly contemplated that both sets of knowledge would be included in the knowledge base. See ‘432 patent, col. 2:58-61; col. 4:8-11. Furthermore, Aeroflex’s attempt to include the following language in the definition - “for each logical step and decision represented in the flowchart” - should be rejected for the reasons discussed *supra*. Accordingly, the Court construes “a set of cell selection rules” as *a set of rules embodying the expert knowledge of highly skilled VLSI designers, each rule having an antecedent portion (e.g., IF) and a consequent portion (e.g. THEN).*

**G. *selecting from said stored data for each of the specified definitions a corresponding integrated circuit hardware cell***

Ricoh contends that the term means “selecting from the plurality of hardware cells in the hardware cell library a hardware cell for performing the desired function of the desired ASIC.” Aeroflex contends that the term means “mapping the specified stored definitions for each logical step and decision represented in the flowchart to a corresponding stored hardware cell description.”

Ricoh’s argues that this term simply refers to the process of selecting hardware cells from those stored in the hardware cell library that can be used to implement the desired functions of the ASIC to be produced. In support of its argument, Ricoh cites the specification language stating that “[t]he Cell Selector 32 is a knowledge based system for selecting a set of optimum cells from the cell library to implement a VLSI system.” ‘432 patent, col. 8:21-23.

Aeroflex argues that its proposed construction is supported by the language in claim 13, which according to Aeroflex, “dictates that mapping the specified definitions to the stored hardware cell descriptions must be performed by a rule-based expert system and not conventional software.” Aeroflex Responsive Brief at 41:3-6. Aeroflex relies upon the following specification language to support its argument: “To design a VLSI system from a flowchart description of a user application, it is necessary to match the functions in a flowchart with cells from a cell library. This mapping needs the use of artificial techniques because the cell selection process is complicated and is done on the

1 basis of a number of design parameters and constraints.” ‘432 patent, col. 8:31-31-37.

2 Although it is a close question, Aeroflex’s argument is ultimately more compelling. As  
3 discussed above, the patent file history demonstrates that the patentee distinguished the present  
4 invention based on the rule-based expert system’s ability “to accomplish a task of selection of cells  
5 from the cell library.” April 1989 Amendment at 10. This amendment strongly suggests that the  
6 mapping of the specified definitions to the stored hardware cells must be performed by a rule-based  
7 system. *See* Aeroflex Responsive Brief at 42. Ricoh’s proposed language does not include a  
8 reference to a “rule-based system.” Aeroflex’s use of the word “mapping” is supported by the  
9 specification language ‘432 patent, col. 8:34; col. 9:53. Furthermore, at the claims construction  
10 hearing, Ricoh’s counsel stated that he had no objection to the use of the term “mapping” in this  
11 context. However, Aeroflex’s inclusion of the phrase “for each logical step and decision represented  
12 in the flowchart” is improper because it attempts to limit the claim to the preferred embodiment of  
13 the flowchart input specification, as discussed *supra*. Therefore, the Court construes “selecting from  
14 said stored data for each of the specified definitions a corresponding integrated circuit hardware cell”  
15 as *mapping the specified stored function to a corresponding stored hardware cell*.

16 **H. said step of selecting a hardware cell comprising applying to the specified**  
17 **definition of the action or condition to be performed**

18 Ricoh argues that the term is defined as “selecting from the plurality of hardware cells in the  
19 hardware cell library a hardware cell . . . through application of the rules; and generating a netlist that  
20 identifies the hardware cells needed to perform the function of the desired ASIC.” Aeroflex  
21 contends that the term should be defined as “the mapping of the specified definitions to the stored  
22 hardware cell descriptions must be performed by applying to the specified definitions in the  
23 flowchart a set of cell selection rules stored in an expert system knowledge base.”

24 The parties proposed constructions are not substantially different. As discussed above,  
25 Aeroflex’s attempt to restrict the term to “definitions in the flowchart” is incorrect. However,  
26 Aeroflex’s proposed use of the term “expert system knowledge base” also seems incorrect because it  
27 is unnecessary here; the term does not require a definition that specifies the location where the cell  
28 selection rules are found. Similarly, Ricoh’s inclusion of “generating a netlist that identifies the

1 hardware cells needed to perform the function of the desired ASIC” seems unnecessary here; such a  
2 definition would function to incorporate a separate step of the claim not covered by the current term.  
3 Accordingly, the Court defines the term as *the mapping of the specified definitions to the stored*  
4 *hardware cell descriptions by applying to the specified definitions a set of cell selection rules.*

5 **I. specifying for each described action and condition of the series one of said stored**  
6 **definitions**

7 Ricoh proposes that this term be construed as “specifying for each desired function to be  
8 performed by the desired ASIC one of the definitions of the architecture independent actions and  
9 conditions stored in the library of definitions that is associated with the desired function.” Aeroflex  
10 contends that the proper construction of the term is “the designer assigns one definition from a set of  
11 stored definitions to each of the logical steps and decisions represented in the flowchart.” The  
12 parties dispute centers around whether the “specifying” step must be performed manually by a user,  
13 or whether the assignment of macros can be done automatically.

14 Ricoh admits that the patent discloses a “manual mapping” embodiment. ‘432 patent, col.  
15 7:24-25 (“Edit actions allows the designer to assign actions to each box.”). However, Ricoh argues  
16 that the construction of the claim should not be limited merely because it is the only embodiment  
17 disclosed. *See Liebel-Flarshiem Co.*, 358 F.3d at 913. Furthermore, Ricoh contends that the patent  
18 describes macros being “mapped” automatically through the application of rules. *See* ‘432 patent,  
19 col. 9:14-18. Ricoh argues that if col. 9:14-18 is read in context, the passage shows that the quoted  
20 rules are to be applied “during this stage,” which refers to the “first step of cell list generation.”  
21 Accordingly, Ricoh contends that this passage does not apply to a statelist in which the “macros”  
22 have already been assigned to the desired actions.

23 Aeroflex disagrees with Ricoh’s proposed construction. First, Aeroflex argues that the  
24 prepositional phrase “for each described action and condition of the series” refers only to the fact that  
25 the “specifying” step is performed for each action and condition in the described series resulting  
26 from the previous “describing” step. Thus, Aeroflex concludes that the claim language for this  
27 “specifying” step requires that “the designer assigns one stored definition for each logical step and  
28 decision described in the flowchart.” Second, Aeroflex argues that other claims demonstrate that for

each action and condition described, this step requires the designer to specify one stored definition (from a macro library) and that this “specifying” step and the previous “describing” step together are the steps that define the input specification for the claimed invention’s method. Third, Aeroflex argues that Ricoh’s proposed construction impermissibly attempts to replace the phrase “for each described action and condition” with the phrase “for each desired function to be performed by the desired ASIC.” Finally, Aeroflex argues that the ‘432 patent does not contain an automated “mapping” embodiment.

The Court finds that Aeroflex’s attempt to limit the “specifying” step to encompass only a user manually assigning a single definition to each action and condition is too narrow of a construction. The plain language of the claim simply does not support this construction, and the Court should not “limit[] the claimed invention to preferred embodiments or specific examples in the specification.” *Ekchian*, 104 F.3d at 1303. Moreover, while Aeroflex is correct that claim 1 and claim 9 require the designer to “specify” one stored definition for each action and condition described, this contention alone does not suggest that the Court should juxtapose these claims onto claim 13. Claim 13 simply does not contain similar language.<sup>9</sup>

Additionally Ricoh’s attempt to replace the phrase “for each described action and condition” with the phrase “for each desired function to be performed by the desired ASIC” is permissible. Throughout the specification, each “action and condition” is referenced as a “function.” See ‘432 patent, col. 2:21-30. Therefore, the Court construes “specifying for each described action and condition of the series one of said stored definitions” as *specifying for each desired functional specification to be performed by the desired ASIC one of the definitions from the set of stored definitions*.

**J. a netlist defining the hardware cells which are needed to perform the desired function of the integrated circuit**

Ricoh contends that the term means “a description of the hardware components (and their interconnections) needed to manufacture the ASIC as used by subsequent processes, e.g., mask

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<sup>9</sup>Aeroflex’s proposed construction is also flawed because of its inclusion of the phrase “logical steps and decisions represented in the flowchart.” See discussion *supra*.

1 development, foundry, etc.” Aeroflex states that the term means “producing a list of the needed  
2 hardware cells by eliminating any mapped hardware cells that are redundant or otherwise  
3 unnecessary, producing a custom controller type hardware cell for providing the needed control for  
4 those other hardware cells, and producing the necessary structural control paths and data paths for  
5 the needed hardware cells and the custom controller.” ‘432 patent, col. 5:38-46.

6 Ricoh’s proposed construction also relies heavily upon language in the specification.  
7 Specifically, Ricoh notes that the specification states that “[t]he list of hardware cells and their  
8 interconnection requirements may be represented in the form of a netlist. From the netlist it is  
9 possible using either known manual techniques or existing VLSI CAD layout systems to generate the  
10 detailed chip level geometrical information (e.g. mask data) required to produce the particular  
11 application specific integrated circuit in chip form.” ‘432 patent, col. 2:42-49. The specification  
12 also states that “[t]he netlist provides all the necessary information required to produce the integrated  
13 circuit. Computer-aided design systems for cell placement and routing are commercially available  
14 which will receive netlist data as input and will lay out the respective cells in the chip, generate the  
15 necessary routing, and produce mask data which can be directly used by the chip foundry in the  
16 fabrication of integrated circuits.”

17 Aeroflex also relies heavily upon the patent’s specification to support its proposed  
18 construction. Aeroflex initially argues that the claim language “generating for the selected . . .  
19 hardware cells, a netlist defining the hardware cells which are needed to perform the desired function  
20 of the integrated circuit” requires that this step eliminate any selected hardware cells that are not  
21 needed. *See* ‘432 patent, col. 13:59-66. Aeroflex also contends that the patent’s specification  
22 defines the “interconnection requirements” for the necessary hardware cells defined in the netlist as  
23 “data and control paths.” *See* ‘432 patent, col. 5:30-35. Finally, Aeroflex contends that a system  
24 controller must be generated for the netlist. In support of its argument, Aeroflex cites language from  
25 the preferred embodiment that states “[t]he netlist includes a custom generated system controller, all  
26 other hardware cells required to implement the necessary operations, and interconnection  
27 information for connecting the hardware cells and the system controller.” ‘432 patent, col. 4:39-43.  
28 Additionally, Aeroflex asserts that the requirement that a controller be generated is also supported by

1 the patent's file history. Specifically, Aeroflex argues that the file history limits the input  
2 specification to exclude register-transfer level descriptions that would define the control for the  
3 hardware cells of the ASIC, and thus a controller must be generated to provide necessary control for  
4 the ASIC.

5 The Court agrees with Ricoh that Aeroflex's arguments regarding "eliminating any mapped  
6 hardware cells that are redundant or otherwise unnecessary" and "producing a custom controller type  
7 hardware cell for providing the needed control for those other hardware cells" bear no relationship to  
8 a plain reading of claim 13. Additionally, contrary to Aeroflex's assertion, a review of the patent file  
9 history does not reveal that a controller must be generated in claim 13. Furthermore, while claim 10  
10 expressly includes the generation of a controller, claim 13 includes no such language. *See* '432  
11 patent, col. 16:1-4 ("The system as defined in claim 9 additionally including control generator means  
12 for generating a controller and control paths for the hardware cells selected by said cell section  
13 means.").

14 The Court also finds that claim 13 does not restrict the interconnection requirements of the  
15 hardware cells to "data and control paths." To be certain, "data and control paths" are the types of  
16 interconnections disclosed in the patent's preferred embodiment. But, the Court should not "limit[]  
17 the claimed invention to preferred embodiments or specific examples in the specification." *Ekchian*,  
18 104 F.3d at 1303. Moreover, while claim 15 expressly includes the generation of control paths,  
19 claim 13 includes no such language. *See* '432 patent, col. 17:1-3 ("A process as defined in claim 13  
20 including the further step of generating data paths for the selected integrated circuit hardware  
21 cells."). For these reasons, the Court agrees with Ricoh's proposed construction of the term. The  
22 Court defines "a netlist defining the hardware cells which are needed to perform the desired function  
23 of the integrated circuit" *as a description of the hardware components (and their interconnections)*  
24 *needed to manufacture the ASIC as used by subsequent processes, e.g., mask development, foundry,*  
25 *etc.*

26 ///

27 ///

28 ///

**CONCLUSION**

Based on the analysis above, the Court adopts the foregoing constructions of the disputed claim terms.

**IT IS SO ORDERED.**

Dated: April 7, 2005

  
MARTIN J. JENKINS  
UNITED STATES DISTRICT JUDGE

## **Exhibit 65**

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Page 1

IN THE UNITED STATES DISTRICT COURT  
NORTHERN DISTRICT OF CALIFORNIA  
SAN FRANCISCO DIVISION

SYNOPSYS, INC.,

Plaintiff,

vs.

NO: CO3-2289 MJJ (EMC)

RICOH COMPANY, LTD.,

Defendant.

/

RICOH COMPANY, LTD.,

Plaintiff,

vs.

NO: CO3-04669 MJJ (EMC)

AEROFLEX INCORPORATED, AMI  
SEMICONDUCTOR, INC., MATROX  
ELECTRONIC SYSTEMS, LTD.,  
MATROX GRAPHICS, INC., MATROX  
INTERNATIONAL CORP. and  
MATROX TECH., INC.,

Defendants.

/

THE DEPOSITION OF: SIMON YOON-PIN FOO

AT THE INSTANCE OF: Ricoh Company, Ltd.

DATE: Wednesday, May 31, 2006

TIME: Commenced at 9:28 a.m.  
Terminated at 4:30 p.m.

PLACE: Marriott Courtyard  
Apalachee Parkway  
Tallahassee, Florida

REPORTED BY: SARAH B. GILROY, RPR, CRR  
Notary Public the State of  
Florida at Large

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Page 2	Page 4
<p>1 APPEARANCES:</p> <p>2 REPRESENTING SYNOPSIS, INC.:</p> <p>3 HENRY C. SU, ESQUIRE</p> <p>4 Howrey LLP</p> <p>5 1950 University Avenue, 4th Floor</p> <p>6 East Palo Alto, California 94303</p> <p>7 REPRESENTING RICOH COMPANY, LTD.:</p> <p>8 ERIC OLIVER, ESQUIRE</p> <p>9 Dickstein, Shapiro, Morin &amp; Oshinsky</p> <p>10 2101 L Street NW</p> <p>11 Washington, DC 20037</p> <p>12</p> <p>13</p> <p>14</p> <p>15</p> <p>16</p> <p>17</p> <p>18</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>	<p>1 Thereupon,</p> <p>2 SIMON YOON-PIN FOO</p> <p>3 was called as a witness, having been first duly sworn,</p> <p>4 was examined and testified as follows:</p> <p>5 DIRECT EXAMINATION</p> <p>6 BY MR. OLIVER:</p> <p>7 Q Good morning.</p> <p>8 A Good morning.</p> <p>9 Q Would you please state your full name for the</p> <p>10 record.</p> <p>11 A Simon Yoon-Pin Foo.</p> <p>12 Q Would you state your current residence</p> <p>13 address.</p> <p>14 A 6239 Middlewood Court, Tallahassee, Florida</p> <p>15 32312.</p> <p>16 Q Handing you what has been marked as Exhibit</p> <p>17 500, bearing production numbers FOO 00001 through</p> <p>18 0008. Do you recognize Exhibit 500?</p> <p>19 A Yes.</p> <p>20 Q What is it?</p> <p>21 A It's my vitae.</p> <p>22 (Exhibit No. 500 was identified for the</p> <p>23 record).</p> <p>24 BY MR. OLIVER:</p> <p>25 Q Did you prepare it?</p>
Page 3	Page 5
<p>1 INDEX</p> <p>2 WITNESS PAGE NO.</p> <p>3 SIMON YOON-PIN FOO</p> <p>4 Direct Examination by Mr. Oliver 4</p> <p>5 INDEX OF EXHIBITS</p> <p>6 NUMBER DESCRIPTION</p> <p>500 CV 4</p> <p>7 501 "Programmable Logic for Parallel</p> <p>8 Convolution" 11</p> <p>502 Architecture of KBMS 28</p> <p>503 Hand-drawn sketch 28</p> <p>504 Hand-drawn sketch 28</p> <p>505 Hand-drawn sketch 28</p> <p>506 Hand-drawn sketch 28</p> <p>507 "Databases and Cell-Selection Algorithms</p> <p>For VLSI Cell Libraries" 80</p> <p>508 "A Knowledge-based System for VLSI</p> <p>Module Selection" 28</p> <p>509 "Framework for Managing VLSI CAD</p> <p>Data" 61</p> <p>510 "VLSI Cell Selection: A Frame-Based</p> <p>Approach" 61</p> <p>511 "A Knowledge-Based VLSI Module Selector</p> <p>With a Built-in Frame-Based Data</p> <p>Base Management System" 87</p> <p>512 Foo work 88</p> <p>513 "A Knowledge-Based VLSI Module Selector</p> <p>With a Built-in Frame-Based Data</p> <p>Base Management System" 88</p> <p>514 Foo work 88</p> <p>515 Foo work 88</p> <p>516 Foo work 88</p> <p>517 "A Knowledge-Based Silicon Compiler for</p> <p>High-Level Behavioral Descriptions" 88</p> <p>518 "A Knowledge-Based Silicon Compiler for</p> <p>High-Level Behavioral Descriptions" 88</p> <p>519 Patent 432 122</p> <p>520 "Translating Behavioral Specifications</p> <p>To VLSI: A Knowledge-Based Approach" 123</p> <p>521 Project Description for ECE890B 152</p> <p>522 "A Knowledge-Based Approach to VLSI CAD" 155</p> <p>24 CERTIFICATE OF OATH 162</p> <p>25 CERTIFICATE OF REPORTER 163</p>	<p>1 A Yes, sir.</p> <p>2 Q When did you prepare it?</p> <p>3 A This vitae was probably prepared in early</p> <p>4 2006.</p> <p>5 Q Is there anything you would add if you were to</p> <p>6 update it today?</p> <p>7 A To the best of my knowledge, no.</p> <p>8 Q Are there any errors that you would correct?</p> <p>9 A To the best of my knowledge, no.</p> <p>10 Q Did you intentionally leave off any</p> <p>11 publications?</p> <p>12 A Could you repeat that question again?</p> <p>13 Q Did you intentionally leave off any</p> <p>14 publications?</p> <p>15 A No, sir.</p> <p>16 Q Where did you do your undergraduate work?</p> <p>17 A The University of South Carolina in Columbia.</p> <p>18 Q Did you have any significant projects towards</p> <p>19 your degree?</p> <p>20 MR. SU: Objection as to form.</p> <p>21 A Could you elaborate -- which degree are you</p> <p>22 referring to, sir?</p> <p>23 BY MR. OLIVER:</p> <p>24 Q Your undergraduate degree.</p> <p>25 A Oh, the undergraduate degree. I -- to the</p>

2 (Pages 2 to 5)

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<p>1 best of my knowledge, for two or three semesters, 2 starting in 1982, I worked as a student research 3 assistant with Dr. Kobayashi. 4 Q Do you remember what you did in that 1982 time 5 frame with Dr. Kobayashi? 6 A Could you elaborate that question? 7 Q Do you remember what you did as a student 8 researcher in 1982 with Dr. Kobayashi? 9 A I was a research assistant for him, and my 10 task was to assist him in research in the area of 11 integrated circuits. 12 Q Anything in particular with respect to 13 integrated circuits? 14 A In particularly logic design, circuit design, 15 literature search, writing of technical papers, and I 16 think that's pretty much the work that I did for him, 17 to the best of my knowledge. 18 Q And all of that was during that time period in 19 1982; is that correct? 20 A Between 1982 and 1983, as an undergraduate 21 research assistant. 22 Q How did you meet Dr. Kobayashi? 23 A I was recruited by him, because at that time I 24 was one of the honor students in electrical 25 engineering department.</p>	<p>1 graduate education? 2 A Telling me which courses to take, advising 3 me -- advising me on courses to take. 4 Q Did you have a master's thesis? 5 A Yes, sir. 6 Q What was your master's thesis? 7 A The title? 8 Q (Nodding head affirmatively). 9 A It's called managing -- "Managing the VLSI CAD 10 Data With a Relational Database System," I believe, to 11 the best of my knowledge. I would be happy to look at 12 my -- maybe I did not specify in my vitae what the 13 title is. 14 Q Was it called managing VLSI -- 15 A Yeah, VLSI CAD data with a relational 16 database, something like that. 17 Q Did Dr. Kobayashi provide you with the idea 18 for your thesis? 19 A No. 20 Q Who did? 21 A The idea of using a relational database system 22 to manage VLSI data actually came from a course that I 23 took with Professor Ronald Bonnell. 24 Q Who is Dr. Bonnell? 25 A Dr. Bonnell teaches the database engineering</p>
Page 7	Page 9
<p>1 Q Did you have any specialties at that time? 2 A Yes. 3 Q What was your specialty? 4 A Digital logic design, and I was particularly 5 interested in integrated circuit design. 6 Q Did Dr. Kobayashi teach any of your 7 undergraduate courses? 8 A Can I -- can you say that question again. 9 Q Did Dr. Kobayashi teach any of your 10 undergraduate courses? 11 A I believe I took the digital logic design 12 under him. 13 Q Do you remember what year? 14 A I believe it was either 1981 or 1982. 15 Q Was Dr. Kobayashi your advisor when you were 16 working towards your master's degree? 17 A Yes, sir. 18 Q When did he start being your advisor? 19 A He was already my advisor when I was a 20 student, research assistant when I was an 21 undergraduate. 22 Q What does it mean to be an advisor? 23 A He basically mentor me. He guide me in the 24 area of graduate education. 25 Q What do you mean by guiding you in the area of</p>	<p>1 course, which I took when I was a graduate student. 2 Q Do you remember what year you took that 3 course? 4 A I believe it was in 1983, late in '83 or early 5 '84. 6 Q Did Dr. Kobayashi advise you with respect to 7 your thesis? 8 A Yes, sir. 9 Q How did he advise you? 10 A He advise me in terms of what courses I needed 11 to complete my degree, and he also advised me on the 12 topic. 13 Q How did he advise you on the topic? 14 A What would be a good topic, a relevant topic 15 at that time. 16 Q What do you mean by "relevant topic at that 17 time"? 18 A Something that is not out of date. 19 Q Did you need help in that regard? 20 A Say that -- 21 MR. SU: Object to form. 22 BY MR. OLIVER: 23 Q Did you need help in that regard? 24 A No. 25 Q But he gave you advice; right?</p>

3 (Pages 6 to 9)

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<p>1 A Yes, sir.</p> <p>2 Q Did he give you any other assistance in your</p> <p>3 master's thesis?</p> <p>4 A He corrected some of my writing, and I believe</p> <p>5 that's about it.</p> <p>6 Q Did he provide you with any design examples?</p> <p>7 MR. SU: Objection as to form.</p> <p>8 A Which design example are you referring to?</p> <p>9 BY MR. OLIVER:</p> <p>10 Q You have a design example in your master's</p> <p>11 called the "Programmable Logic For Parallel</p> <p>12 Convolution"?</p> <p>13 A I don't recall --</p> <p>14 Q Would you like to see a copy of your master's</p> <p>15 to refresh your recollection?</p> <p>16 A I guess my response is that I don't recall how</p> <p>17 much he assisted me in developing that example.</p> <p>18 Q Do you have any doubt that he assisted you in</p> <p>19 some respect?</p> <p>20 A He may have assisted me in some respect, but</p> <p>21 I'm the one who implemented the design example.</p> <p>22 Q What do you mean "implemented the design</p> <p>23 example"?</p> <p>24 A In other words, I started from the conceptual</p> <p>25 design and completed a whole process to the integrated</p>	<p>1 Q Who had the underlying idea for Exhibit 501?</p> <p>2 A When you say "underlying idea," what do you</p> <p>3 mean?</p> <p>4 Q The primary idea behind writing the paper.</p> <p>5 MR. SU: Objection as to form.</p> <p>6 A Are you talking about the person who wrote the</p> <p>7 whole paper?</p> <p>8 BY MR. OLIVER:</p> <p>9 Q No. I'm asking you about the underlying idea</p> <p>10 of the paper.</p> <p>11 A Are you referring to who came up with the</p> <p>12 title of the paper?</p> <p>13 Q Only if the title reflects the idea behind the</p> <p>14 paper.</p> <p>15 A Again, like I mentioned earlier, it was our</p> <p>16 paper. We work together.</p> <p>17 Q Do you believe you came up with the idea</p> <p>18 together?</p> <p>19 A Possibly.</p> <p>20 Q Do you know for sure?</p> <p>21 A It's been over 20 years. I do not recall the,</p> <p>22 you know, the actual conversation that led to this</p> <p>23 paper. But at that time I was working with him.</p> <p>24 Q Whose idea was it to publish this paper?</p> <p>25 A It was Kobayashi's idea.</p>
Page 11	Page 13
<p>1 circuit description at the mask level.</p> <p>2 Q Did you coauthor a paper with Dr. Kobayashi</p> <p>3 regarding programmable logic for parallel convolution?</p> <p>4 A Yes, sir.</p> <p>5 Q Was that paper based on your work?</p> <p>6 A Can I look at a paper for details, please?</p> <p>7 Q Handing you what has been marked as Exhibit</p> <p>8 501, bearing production numbers KBSC 00918 through</p> <p>9 0922. This is a document entitled "Programmable Logic</p> <p>10 For Parallel Convolution." Would you take a moment to</p> <p>11 review that Exhibit 501, please.</p> <p>12 (Exhibit No. 501 was identified for the</p> <p>13 record).</p> <p>14 A (Witness complies). Okay.</p> <p>15 BY MR. OLIVER:</p> <p>16 Q Was Exhibit 501 based on your work?</p> <p>17 A Which work are you referring to, sir?</p> <p>18 Q Any work.</p> <p>19 A Yes, sir.</p> <p>20 Q Was Exhibit 501 based on Dr. Kobayashi's work?</p> <p>21 A Not entirely.</p> <p>22 Q In any respect?</p> <p>23 A It was our work.</p> <p>24 Q You did it jointly?</p> <p>25 A That's correct.</p>	<p>1 Q Do you know why he listed you as a coauthor?</p> <p>2 A Because I assisted in the -- either the idea</p> <p>3 of the paper or writing of the paper or both.</p> <p>4 Q Has he ever omitted you from a paper that he</p> <p>5 has published when you had either the idea of the</p> <p>6 paper or writing of the paper?</p> <p>7 A Say that again.</p> <p>8 Q Has Dr. Kobayashi ever omitted you from a</p> <p>9 published paper when you had either assisted in the</p> <p>10 idea of the paper or in the writing of the paper or</p> <p>11 both?</p> <p>12 A Possibly.</p> <p>13 Q Do you know for a fact?</p> <p>14 A I believe there were one presentation that he</p> <p>15 has made but my name was not -- was omitted.</p> <p>16 Q Do you know what presentation that was?</p> <p>17 A I believe, to the best of my recollection,</p> <p>18 he -- Dr. Kobayashi has presented a talk at</p> <p>19 Greenville, South Carolina that was very much my work.</p> <p>20 Q Did that talk -- strike that. Did that talk</p> <p>21 result in a published paper?</p> <p>22 A I do not recall that.</p> <p>23 Q Have there been any other papers which you</p> <p>24 believe Dr. Kobayashi omitted you from the paper?</p> <p>25 A To the best of my knowledge, I do not know.</p>

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<p>1 Q How did you learn of that Greenville, South 2 Carolina presentation that you spoke about in your 3 previous answer? 4 A I believe I have seen it somewhere, either on 5 the Internet or in some other forum. 6 Q When did you first see it? 7 A I believe it was recently. 8 Q When you say "recently," what do you mean? 9 A Within a month. 10 Q Is that the first time you saw it? 11 A Yes, sir. 12 Q How did you feel when you saw it? 13 A I was flabbergasted. 14 Q Why? 15 A Because the description was taken out of my 16 work, and I was not given credit. 17 Q Was there any part of that paper that could 18 only be attributed to Dr. Kobayashi? 19 A Say that again. 20 Q Was there any part of that paper that could 21 only be attributed to Dr. Kobayashi? 22 A No. 23 Q Nothing? 24 A I would not say nothing. I would not say, you 25 know, entirely my, you know, presentation. But it is</p>	<p>1 Q Yes. 2 A I believe I did. 3 Q Were you doing any searches to try to find it? 4 A Yes, sir. 5 Q Why were you doing those searches? 6 A Why was I doing the search's? 7 Q Yes. 8 A I was -- I wanted to know what's out there. 9 Q Why? 10 A That, you know, my idea, I wanted to see 11 how -- if anybody has taken my idea and published it. 12 Q How old is that idea? 13 A How old is that idea? 14 Q (Nodding head affirmatively). 15 A This idea was back in -- it started back in -- 16 can I ask you to clarify the idea? What idea are you 17 talking about? 18 Q I don't know. You talked about the idea for 19 several minutes now. So whatever idea that you're 20 talking about that you were searching for. 21 A The idea that I'm referring to is the cell 22 selection. 23 Q I don't remember seeing any recent articles by 24 you in the past 15 or so years on cell selection; is 25 that true?</p>
Page 15	Page 17
<p>1 possible that he could paraphrase it. 2 Q What do you mean, "he could paraphrase it"? 3 A For example, a description could be, you know, 4 describing a number of ways. He could, you know, by 5 his word, you know, describe in another form. But 6 it's also basically the same idea. 7 Q Do you believe it was your idea alone? 8 A I would not say entirely my idea alone. But I 9 definitely played a big role in it. 10 Q What role did you play? 11 A I developed the program for it, and I came up 12 with the original idea for it. 13 Q Did you try to contact Dr. Kobayashi once you 14 learned of this presentation or paper? 15 A No, sir. 16 Q What did you do after you learned of this 17 paper? 18 A I did nothing. 19 Q How did you find this paper? 20 A It is off the Internet, to the best of my 21 recollection. 22 Q Did you find it off the Internet? 23 A Say that again. 24 Q Did you find it off of the Internet? 25 A Did I find off the Internet?</p>	<p>1 A That's correct. 2 Q So why is it just recently that you're 3 interested in doing research on cell selection? 4 A After I was contacted by your attorneys 5 regarding the patent, the 432 patent, I -- that got me 6 interested. 7 Q Did you review the 432 patent? 8 A Yes, sir. 9 Q Were you flabbergasted when you saw the 432 10 patent? 11 A Absolutely. 12 Q Why is that? 13 A Because a number of the parts of the patent 14 talks about the work that I did. 15 Q Are you doing any consulting work for any 16 parties in this litigation? 17 A Say that again. 18 Q Are you doing any consulting work for any 19 parties in this litigation? 20 A What do you mean by "consulting work"? 21 Q Are you being paid to review or discuss any 22 matters with anyone connected with this litigation? 23 A Yes, sir. 24 Q Who are you working for? 25 A I'm a consultant for Howrey.</p>

5 (Pages 14 to 17)

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<p>1 Q How much are you being paid?</p> <p>2 A Are you talking about hourly rate?</p> <p>3 Q I don't -- however you're being compensated</p> <p>4 for your consulting work.</p> <p>5 A I'm being compensated for the number of hours</p> <p>6 I put in.</p> <p>7 Q What is your hourly rate?</p> <p>8 A \$250 an hour.</p> <p>9 Q Are you being compensated for today's</p> <p>10 deposition?</p> <p>11 A I believe so.</p> <p>12 Q How much have you billed Howrey for consulting</p> <p>13 services in this litigation so far to date?</p> <p>14 A To date --</p> <p>15 MR. SU: I'm going to object to that as work</p> <p>16 product. We've not identified him as a testifying</p> <p>17 expert.</p> <p>18 MR. OLIVER: Work product?</p> <p>19 MR. SU: Yes.</p> <p>20 MR. OLIVER: His hourly rate.</p> <p>21 MR. SU: No. He just testified as to his</p> <p>22 hourly rate. You want to know now how many hours</p> <p>23 he's billed.</p> <p>24 MR. OLIVER: Are you going to instruct him not</p> <p>25 to answer the question?</p>	<p>1 A There was one person from Shapiro, Weinstein</p> <p>2 law firm that contacted me.</p> <p>3 Q When did he contact you?</p> <p>4 A I believe, to the best of my recollection, the</p> <p>5 person contacted me in either 2002 or early 2003.</p> <p>6 Q Did you sign a nondisclosure agreement?</p> <p>7 A That was not mentioned in the conversation.</p> <p>8 Q Do you remember the conversation being under</p> <p>9 some understanding of confidentiality?</p> <p>10 A That was not mentioned.</p> <p>11 Q Did you reveal any of your discussions with</p> <p>12 Mr. Weinstein to anyone at Howrey?</p> <p>13 A No, sir.</p> <p>14 Q How much time did you spend preparing for your</p> <p>15 deposition today?</p> <p>16 A Are you talking about this morning?</p> <p>17 Q For your -- in preparation for today's</p> <p>18 deposition.</p> <p>19 A Okay. Yesterday I spent about three hours.</p> <p>20 Q What did you do in those three hours?</p> <p>21 A I reviewed the evidence or documents that I</p> <p>22 have provided to my counsel.</p> <p>23 Q Did you speak with anyone in preparation of</p> <p>24 today's deposition?</p> <p>25 A No other person other than my counsel.</p>
Page 19	Page 21
<p>1 MR. SU: Yes.</p> <p>2 BY MR. OLIVER:</p> <p>3 Q Are you going to answer the question?</p> <p>4 A No.</p> <p>5 Q Why not?</p> <p>6 A By advice from my counsel.</p> <p>7 Q When did you start working as a consultant for</p> <p>8 Howrey?</p> <p>9 A I started in, I believe, to the best of my</p> <p>10 knowledge, in middle of April 2006.</p> <p>11 Q Who first approached you about being a</p> <p>12 consultant?</p> <p>13 MR. SU: Objection, work product.</p> <p>14 BY MR. OLIVER:</p> <p>15 Q I'm just asking you for the name of the person</p> <p>16 who approached you.</p> <p>17 A I believe is Jackie Fink of Howrey.</p> <p>18 Q Do you know when she first approached you?</p> <p>19 A I believe early April, to the best of my</p> <p>20 knowledge.</p> <p>21 Q You made a reference to discussing attorney</p> <p>22 from my firm, which I assume you are referring to</p> <p>23 Dickstein, Shapiro; do you remember that?</p> <p>24 A Yes, sir.</p> <p>25 Q What were you referring to?</p>	<p>1 Q Who did you speak with?</p> <p>2 A I spoke with Mr. Su.</p> <p>3 Q Anyone else?</p> <p>4 A Nobody else.</p> <p>5 Q You didn't speak with Jackie Fink?</p> <p>6 A No, sir.</p> <p>7 Q Were you given a retainer to be a consultant</p> <p>8 for Howrey?</p> <p>9 A Could you explain that retainer.</p> <p>10 Q Were you given a payment in advance?</p> <p>11 A No, sir.</p> <p>12 Q Are you being represented by counsel today?</p> <p>13 A Yes, sir.</p> <p>14 Q Mr. Su your counsel?</p> <p>15 A That's correct.</p> <p>16 Q When did he become your counsel?</p> <p>17 A I believe Mr. Su became my counsel in the</p> <p>18 middle or early part of May.</p> <p>19 Q Why did you retain counsel?</p> <p>20 A The reason was, I was subpoenaed.</p> <p>21 Q Have you done any research with respect to</p> <p>22 rule-based systems?</p> <p>23 A Yes, sir.</p> <p>24 Q What type of research have you done?</p> <p>25 A I have done some research on rule-based system</p>

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Page 22	<p>1 as part of some course work that I took when I was a</p> <p>2 graduate student at the University of South Carolina.</p> <p>3 Q Do you remember what year?</p> <p>4 A To the best of my knowledge, it was in 1983</p> <p>5 and 1984.</p> <p>6 Q Do you remember how many courses were involved</p> <p>7 with this rule-based system research?</p> <p>8 A Say that question again.</p> <p>9 Q Do you remember how many courses you took with</p> <p>10 respect to the rule-based system research?</p> <p>11 A I would say approximately four or five</p> <p>12 graduate courses.</p> <p>13 Q Do you know who taught those courses?</p> <p>14 A The two or three that were taught by Professor</p> <p>15 Bonnell, and one by Michael Huens (phonetic) and one</p> <p>16 by Larry Stephens, and possibly more professors.</p> <p>17 Q Did your research involve the use of</p> <p>18 rule-based systems in VLSI design?</p> <p>19 A Yes, sir.</p> <p>20 Q Is that when you first learned of rule-based</p> <p>21 systems in VLSI design?</p> <p>22 A Say that again.</p> <p>23 Q Is that when you first learned of rule-based</p> <p>24 systems in VLSI design?</p> <p>25 MR. SU: Objection to form.</p>	Page 24
Page 23	<p>1 A No, sir.</p> <p>2 BY MR. OLIVER:</p> <p>3 Q When is the first time you learned of</p> <p>4 rule-based systems in VLSI design?</p> <p>5 A That idea probably came from a course or a</p> <p>6 number of courses that I took in the area of VLSI</p> <p>7 design.</p> <p>8 Q When did you take those courses?</p> <p>9 A Also in early or late 1983 and 1984.</p> <p>10 Q How many courses did you take in that respect?</p> <p>11 A When you say "in that respect," are you</p> <p>12 referring to VLSI design?</p> <p>13 Q Rule-based systems in VLSI design.</p> <p>14 A Let me --</p> <p>15 Q Strike that. How many courses involving VLSI</p> <p>16 design did you take that introduced you to the idea of</p> <p>17 rule-based systems?</p> <p>18 A Well let me say one thing. The VLSI design</p> <p>19 that I took did not -- has no mention about rule-based</p> <p>20 design. The idea of a rule-based systems for VLSI</p> <p>21 design is a research idea. The VLSI design course and</p> <p>22 the rule-based system course are two separate courses.</p> <p>23 Q Did the rule-based system courses involve VLSI</p> <p>24 design?</p> <p>25 A No, sir.</p>	Page 25

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Page 26	<p>1 A Could you explain that again.</p> <p>2 Q Did anything provide you with any unique</p> <p>3 insight that led you to believe that applying</p> <p>4 rule-based systems to VLSI would be a unique idea?</p> <p>5 A It is based on the papers that I have read,</p> <p>6 and I felt that this is an area that needs to be</p> <p>7 researched. It has not been extensively done. It's</p> <p>8 not been many publications in that area.</p> <p>9 Q What year did you -- strike that. As a result</p> <p>10 of the class project, were these papers that you</p> <p>11 identified on pages seven and eight written?</p> <p>12 A What? Say that again.</p> <p>13 Q As a result of your class project with</p> <p>14 Dr. Bonnell, did you write the papers indicated on</p> <p>15 pages seven and eight of Exhibit 500?</p> <p>16 A The courses that I took under Professor</p> <p>17 Bonnell has a direct influence on those two papers.</p> <p>18 Q What did you produce as a result of your class</p> <p>19 project with Dr. Bonnell?</p> <p>20 A A class report.</p> <p>21 Q Did you produce a class report in this</p> <p>22 litigation?</p> <p>23 A No, sir.</p> <p>24 Q Why is that?</p> <p>25 A I could not find the class report.</p>	Page 28	<p>1 0226. And Exhibit 506 bears production numbers FOO</p> <p>2 000256 through 263.</p> <p>3 (Exhibit Nos. 502 through 506 were identified</p> <p>4 for the record.)</p> <p>5 A Okay. I'm finished.</p> <p>6 BY MR. OLIVER:</p> <p>7 Q Do Exhibits 502 through 506 comprise the notes</p> <p>8 for your class project with Dr. Bonnell?</p> <p>9 A I would not say the Exhibits 502 through 506</p> <p>10 is entirely came out of the course with Professor</p> <p>11 Bonnell. Part of it, maybe, but not entirely.</p> <p>12 Q Would you turn to Exhibit 502.</p> <p>13 A (Witness complies) okay.</p> <p>14 Q Did you prepare Exhibit 502?</p> <p>15 A Yes, sir.</p> <p>16 Q When did you prepare it?</p> <p>17 A Are you referring to the entire 502?</p> <p>18 Q Are there parts of Exhibit 502 that were not</p> <p>19 prepared at the same time?</p> <p>20 A Possibly.</p> <p>21 Q Are you able to identify those parts?</p> <p>22 A I can try.</p> <p>23 Q Are you able to identify what parts of Exhibit</p> <p>24 502 were prepared in connection with your class</p> <p>25 project for Dr. Bonnell?</p>
Page 27	<p>1 Q You indicated that you produced some notes; is</p> <p>2 that correct?</p> <p>3 A That's correct.</p> <p>4 Q Are you able to identify those notes?</p> <p>5 A Yes, sir.</p> <p>6 Q Are the notes hand-drawn sketches?</p> <p>7 A They include both hand-drawn sketches and</p> <p>8 computer -- computer-plotted diagrams.</p> <p>9 Q Is there any source code?</p> <p>10 A Yes, sir.</p> <p>11 Q What type of source code?</p> <p>12 A Those source codes are written in C language.</p> <p>13 Q As a part of your class project?</p> <p>14 A That's correct.</p> <p>15 Q I'm handing you what has been marked as</p> <p>16 Exhibits 502, 503, 504, 505, 506. Would you take a</p> <p>17 moment to review these documents and let me know when</p> <p>18 you're finished.</p> <p>19 A Okay.</p> <p>20 MR. OLIVER: For the record, Exhibit 502 bears</p> <p>21 production numbers FOO 000192 through 0198.</p> <p>22 Exhibit 508 bears production numbers FOO 000199</p> <p>23 through 0203. Exhibit 504 bears production numbers</p> <p>24 FOO 000204 through 0209. Exhibit 505 bears</p> <p>25 production numbers FOO -- sorry, FOO 000216 through</p>	Page 29	<p>1 A (Examining document). I would say page 00192,</p> <p>2 00193, 00196, 00197, 00198 is inspired by a course</p> <p>3 that I took with Professor Bonnell.</p> <p>4 Q What do you mean by "inspired"?</p> <p>5 A Based on the material that he taught in class</p> <p>6 that taught me how to take what is learned in class</p> <p>7 and apply to solve a particular problem.</p> <p>8 Q Is there any part of Exhibit 502 that you</p> <p>9 prepared in connection with your class project for</p> <p>10 Dr. Bonnell?</p> <p>11 A Say that again.</p> <p>12 Q Is there any part of Exhibit 502 that you</p> <p>13 prepared in connection with, not inspired by, but in</p> <p>14 connection with, simultaneously, with your class</p> <p>15 project for Dr. Bonnell?</p> <p>16 A I do not recall directly, since I don't have</p> <p>17 the final report that I presented in the class for</p> <p>18 Professor Bonnell.</p> <p>19 Q Earlier you indicated that you had notes that</p> <p>20 you produced in this litigation that were regarding</p> <p>21 your class project with Dr. Bonnell. Is that not</p> <p>22 true?</p> <p>23 A The statement I made was referring -- was --</p> <p>24 it was related to the material that they present in</p> <p>25 the class for Professor Bonnell. But, again, like I</p>

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<p>1 mentioned, I don't have the class report, so I don't</p> <p>2 know if there is any page in here that's exactly a</p> <p>3 copy for the class project. This could be a draft or</p> <p>4 sketch for a subsequent final report for the class.</p> <p>5 Q Can you describe your class project?</p> <p>6 A The class project is -- it's a well-defined</p> <p>7 project that you -- that has an abstract title and</p> <p>8 objective. And when that task is completed, you have</p> <p>9 to write a final report.</p> <p>10 Q Do you remember the contents of your final</p> <p>11 report?</p> <p>12 A To the best of my knowledge, I -- it's been so</p> <p>13 many years, I just could not remember the details of</p> <p>14 the final report.</p> <p>15 Q Do you believe that you showed your final</p> <p>16 report to Dr. Kobayashi?</p> <p>17 A Possibly.</p> <p>18 Q You don't know for sure?</p> <p>19 A I don't know for sure.</p> <p>20 Q Do you believe that Dr. Kobayashi used your</p> <p>21 final report in preparing any publications for which</p> <p>22 he omitted your name?</p> <p>23 A That is possible.</p> <p>24 Q You don't know for sure?</p> <p>25 A I don't know for sure.</p>	<p>1 marketable. I didn't say "published." Did I say</p> <p>2 "published"?</p> <p>3 Q Yes.</p> <p>4 A Okay. Then I should strike out that. What I</p> <p>5 meant is, a product that is marketable, marketable,</p> <p>6 finished product.</p> <p>7 Q Did you complete that task?</p> <p>8 A I never quite complete the task to the stage</p> <p>9 where it's marketable.</p> <p>10 Q What was that product?</p> <p>11 A That product is the cell selector module.</p> <p>12 Q What does the cell selector do?</p> <p>13 A It selects a list of VLSI cells necessary to</p> <p>14 implement a particular function or description, and it</p> <p>15 optimize the list of cells.</p> <p>16 Q When did you complete that?</p> <p>17 A I completed the program, to the best of my</p> <p>18 knowledge, in 1985 or '86.</p> <p>19 Q What was the name of that program?</p> <p>20 A The program started out with the name Fame,</p> <p>21 and then it evolved into a subsequent version of it</p> <p>22 called Neptune.</p> <p>23 Q When was it called Neptune?</p> <p>24 A It was called Neptune, I believe, in 1986.</p> <p>25 Q Did it have the same functionality that you</p>
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<p>1 Q Do you know if he did it intentionally?</p> <p>2 A I do not know for sure.</p> <p>3 Q Do you like Dr. Kobayashi?</p> <p>4 A Yes, I do like him.</p> <p>5 Q Do you believe he would do anything like that</p> <p>6 intentionally?</p> <p>7 A I really don't know exactly, you know, what he</p> <p>8 published out of the work that I presented to him,</p> <p>9 because I'm working under him, and I don't question</p> <p>10 his -- what he did, since he's my boss.</p> <p>11 Q At one point you switched advisors from</p> <p>12 Dr. Kobayashi to somebody else; is that correct?</p> <p>13 A That's correct.</p> <p>14 Q Why did you do that?</p> <p>15 A The reason I did that was because Kobayashi</p> <p>16 made a -- what I call a unethical or unofficial</p> <p>17 requirement on me, that I have to have finished</p> <p>18 published product on the cell selection module before</p> <p>19 I could graduate.</p> <p>20 Q When you say a "finished published product,"</p> <p>21 what do you mean?</p> <p>22 A Meaning a completed program that is ready to</p> <p>23 be marketed.</p> <p>24 Q What do you mean "published"?</p> <p>25 A That means, you know, I say -- I said it's</p>	<p>1 just described?</p> <p>2 A It just have improved functionality of the</p> <p>3 earlier version of Fame.</p> <p>4 Q Both Fame and Neptune selected a list of VLSI</p> <p>5 cells to implement?</p> <p>6 A That's correct, sir.</p> <p>7 Q What did you mean when you said "cells"?</p> <p>8 A Cells are the building blocks of integrated</p> <p>9 circuits necessary to implement a particular function.</p> <p>10 Q Can you give us an example?</p> <p>11 A For example, an adder, it takes two numbers,</p> <p>12 add them and then produce one output.</p> <p>13 Q Were the cells defining a particular type of</p> <p>14 adder?</p> <p>15 A That's correct. That could be different cells</p> <p>16 of the same function.</p> <p>17 Q Why did you call them cells?</p> <p>18 A The reason we call them cells, because these</p> <p>19 are the basic building blocks, just like in the tree</p> <p>20 structure, at the bottom of a tree structure is, you</p> <p>21 know, the leaves or the cells.</p> <p>22 Q Were these cells technology specific?</p> <p>23 A Yes, sir.</p> <p>24 Q What was the smallest building block?</p> <p>25 A The smallest building block is a transistor.</p>

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Page 34	<p>1 Q Have you called them modules before?</p> <p>2 A That's correct.</p> <p>3 Q Do you find cells and modules to be</p> <p>4 interchangeable?</p> <p>5 A That's correct.</p> <p>6 Q Just so we're clear, you do not have any notes</p> <p>7 or papers that reflect the final product from your</p> <p>8 class project with Dr. Bonnell; is that correct?</p> <p>9 A Say that again.</p> <p>10 Q You do not have any notes or other papers that</p> <p>11 reflect the final product produced pursuant to your</p> <p>12 class project with Dr. Bonnell; is that correct?</p> <p>13 A That's correct.</p> <p>14 Q Why didn't you write your master thesis on the</p> <p>15 use of rule-based systems in VLSI?</p> <p>16 A I believe the reason was, at that time I</p> <p>17 was -- I was very much interested in the database</p> <p>18 design course that was offered by Professor Bonnell.</p> <p>19 Q Did you not think the rule-based application</p> <p>20 in VLSI was significant work?</p> <p>21 A Subsequently when I took the rule-based</p> <p>22 systems, I learned that it was -- it was going to be</p> <p>23 the new trend in the VLSI design.</p> <p>24 Q Why didn't you pursue it?</p> <p>25 A The master's thesis was inspired by the</p>	Page 36	<p>1 A I was working as a research associate,</p> <p>2 research assistant under him.</p> <p>3 Q At the University of South Carolina?</p> <p>4 A That's correct, sir.</p> <p>5 Q Did you not work at his company, ICC?</p> <p>6 A I did as a consultant, sir.</p> <p>7 Q When did you work as a consultant for ICC?</p> <p>8 A I believe that was in 1986 and early part of</p> <p>9 '87.</p> <p>10 Q When Dr. Kobayashi allegedly made this</p> <p>11 requirement to have a finished, published product,</p> <p>12 were you working for ICC?</p> <p>13 A That's correct.</p> <p>14 Q Was he requiring you to make this product for</p> <p>15 ICC?</p> <p>16 A Say that again.</p> <p>17 Q Was he requiring you to make this product for</p> <p>18 ICC?</p> <p>19 A Which product are you referring to?</p> <p>20 Q The commercial or marketable product that you</p> <p>21 later called Neptune, the cell selector.</p> <p>22 A Okay. And what was the question again?</p> <p>23 Q Whether or not Dr. Kobayashi was requiring you</p> <p>24 to make this product for ICC.</p> <p>25 A That's correct.</p>
Page 35	<p>1 earlier course that I took under Professor Bonnell,</p> <p>2 which is the database system. So I took that database</p> <p>3 systems under Bonnell first. And then subsequently I</p> <p>4 took another course or two under Professor Bonnell in</p> <p>5 the area of artificial intelligence or rule-based</p> <p>6 knowledge-based systems.</p> <p>7 Q After your master thesis was already</p> <p>8 completed?</p> <p>9 A Probably in the process.</p> <p>10 Q Why didn't you pursue rule-based systems in</p> <p>11 VLSI for your Ph.D.?</p> <p>12 A I would have, and I should have, and I could</p> <p>13 have, but remember I told you earlier about the</p> <p>14 requirement from Dr. Kobayashi for me to graduate,</p> <p>15 that requirement to me is not acceptable. So it was</p> <p>16 subsequently I parted ways with him.</p> <p>17 And I clearly remember when I parted ways with</p> <p>18 him, he told me that I cannot work in that area</p> <p>19 anymore, as long as I stay in University of South</p> <p>20 Carolina.</p> <p>21 Q What year was that?</p> <p>22 A That happened in -- to the best of my</p> <p>23 knowledge, that happened in early part of 1987.</p> <p>24 Q Were you working under Dr. Kobayashi at the</p> <p>25 University of South Carolina?</p>	Page 37	<p>1 Q So his demands weren't for your degree, but</p> <p>2 for ICC?</p> <p>3 A Say that again.</p> <p>4 Q His demands to have a commercial product were</p> <p>5 for the company ICC, not for the University of South</p> <p>6 Carolina; isn't that correct?</p> <p>7 A That's not for my degree.</p> <p>8 Q Exactly. It's not -- it wasn't for your</p> <p>9 degree. It was for his company, ICC; right?</p> <p>10 A That's correct.</p> <p>11 Q So he wasn't demanding that you make the</p> <p>12 product so that you graduate, he was demanding that</p> <p>13 you make the product because you were also an employee</p> <p>14 or consultant for ICC; isn't that correct?</p> <p>15 A No. No. I think you have misunderstood here.</p> <p>16 What happened is this: The line between academia and</p> <p>17 his company was blurred; okay? And when he made that</p> <p>18 requirement that I got to have the finished product</p> <p>19 marketable for ICC before I could graduate, now to me</p> <p>20 that is a conflict of interest.</p> <p>21 Q Did he do that because he thought that your</p> <p>22 work to date had not been fully researched?</p> <p>23 A Say that again.</p> <p>24 Q Did he make that requirement because your work</p> <p>25 to date had not been fully researched?</p>

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<p>1 MR. SU: Objection to form.</p> <p>2 A Fully researched by who?</p> <p>3 BY MR. OLIVER:</p> <p>4 Q You.</p> <p>5 A By me?</p> <p>6 Q Yes.</p> <p>7 A I still don't get your question.</p> <p>8 Q Did he make the requirement that you have a</p> <p>9 marketable product because he felt that your work to</p> <p>10 date had not been fully researched?</p> <p>11 A Fully researched? What do you mean by "fully</p> <p>12 researched"?</p> <p>13 Q It was not complete.</p> <p>14 A My work was completed when we made those</p> <p>15 publications.</p> <p>16 Q Your work for your master's?</p> <p>17 A No, for the dissertation.</p> <p>18 Q For your Ph.D.?</p> <p>19 A That's correct, yeah.</p> <p>20 Q What was your dissertation on for your Ph.D.?</p> <p>21 A My dissertation was on neural networks for job</p> <p>22 shop scheduling.</p> <p>23 Q How was Dr. Kobayashi able to somehow restrict</p> <p>24 your ability to graduate with a Ph.D. by requiring you</p> <p>25 to have a marketable product?</p>	<p>1 master -- a Ph.D. dissertation on cell selection?</p> <p>2 A That's correct, a knowledge-based cell</p> <p>3 selection system.</p> <p>4 Q Why did you change to neural networks?</p> <p>5 A The reason I had to switch over to a neural</p> <p>6 networks is because Dr. Kobayashi, who was a tenured</p> <p>7 professor at that time in the department, he has the,</p> <p>8 you know, authority, I'm pretty sure. And he told me</p> <p>9 specifically that if I left him, that I cannot pursue</p> <p>10 anything, any topic in the area of VLSI research, that</p> <p>11 I have to do something outside of that area.</p> <p>12 Q And despite all that, you still like him?</p> <p>13 A I think he's a nice person.</p> <p>14 Q Despite that?</p> <p>15 A Yes.</p> <p>16 Q Would you like to take a break?</p> <p>17 A Yes.</p> <p>18 (Short recess).</p> <p>19 MR. OLIVER: Back on the record.</p> <p>20 A I would like to clarify two items that were</p> <p>21 discussed earlier. One is the program called Fame.</p> <p>22 There is -- and Neptune. There is a distinction</p> <p>23 between the two. The Fame is a frame-based database</p> <p>24 system for managing VLSI design, whereas Neptune is a</p> <p>25 frame-based database system with a cell selection</p>
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<p>1 A That was his verbal condition to me before I</p> <p>2 could defend my dissertation. So, in other words, if</p> <p>3 I don't get his marketable product completed, he would</p> <p>4 not have the defense and certainly would not even sign</p> <p>5 the dissertation.</p> <p>6 So if that dissertation is not signed, you</p> <p>7 don't graduate.</p> <p>8 Q Were you already working in -- towards your</p> <p>9 neural networks dissertation at that time?</p> <p>10 A No, sir. I did not neural network</p> <p>11 dissertation after I parted ways with Dr. Kobayashi.</p> <p>12 Q So what topic was he going to refuse to defend</p> <p>13 by not having you produce a marketable product?</p> <p>14 MR. SU: Objection as to form.</p> <p>15 A Could you say that question again?</p> <p>16 BY MR. OLIVER:</p> <p>17 Q What topic were you working towards a Ph.D. at</p> <p>18 that time that he was requiring you to have a</p> <p>19 marketable product before you graduated?</p> <p>20 A Are you talking about Dr. Kobayashi?</p> <p>21 Q Yes.</p> <p>22 A Okay. He was the -- the dissertation I was</p> <p>23 referring to for Kobayashi is going to be on the cell</p> <p>24 selection.</p> <p>25 Q So originally you were going to have a</p>	<p>1 algorithm incorporated in it.</p> <p>2 And the second clarification is that the</p> <p>3 Exhibit 502 through 506 are not notes directly from</p> <p>4 Professor Bonnell's class. Those are not class notes.</p> <p>5 Q Why did you make that clarification?</p> <p>6 A Say that again.</p> <p>7 Q Why did you make those clarifications?</p> <p>8 A On further thoughts, I may have, you know,</p> <p>9 accidentally implied that they are class notes, when</p> <p>10 they are not.</p> <p>11 Q On the first clarification?</p> <p>12 A On the second clarification.</p> <p>13 Q And on the first clarification --</p> <p>14 A That's correct, yes.</p> <p>15 Q What made you make that clarification?</p> <p>16 A Because earlier I may have implied that Fame</p> <p>17 and Neptune are the same thing, when in fact that they</p> <p>18 are not.</p> <p>19 Q Did your attorney advise you that you should</p> <p>20 make these clarifications?</p> <p>21 MR. SU: Objection, privilege.</p> <p>22 BY MR. OLIVER:</p> <p>23 Q Just a simple yes or no.</p> <p>24 MR. SU: I instruct the witness not to answer.</p> <p>25 BY MR. OLIVER:</p>

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<p>1 Q Will you answer the question?</p> <p>2 A On the advice of my attorney, I would not.</p> <p>3 Q Is there a difference between a frame-based</p> <p>4 system and a rule-based system?</p> <p>5 A Yes, sir.</p> <p>6 Q What is the difference?</p> <p>7 A A frame-based system is basically a</p> <p>8 representation system for storing information, whereas</p> <p>9 a rule-based system is a system for making decisions.</p> <p>10 Q Can you have a rule-based system that utilizes</p> <p>11 a frame-based database?</p> <p>12 A That's correct.</p> <p>13 Q Would you turn back to Exhibit 502.</p> <p>14 A (Witness complies).</p> <p>15 Q I believe earlier you said certain pages of</p> <p>16 Exhibit 502 were inspired by your class with</p> <p>17 Dr. Bonnell; isn't that correct?</p> <p>18 A That's correct, sir.</p> <p>19 Q Why were they inspired by your class with</p> <p>20 Dr. Bonnell?</p> <p>21 A Because the descriptions are rule-based</p> <p>22 descriptions.</p> <p>23 Q Is that the only reason?</p> <p>24 A That's correct.</p> <p>25 Q You prepared all of the pages of Exhibit 502;</p>	<p>1 Q Let's go back and restate it. When did you</p> <p>2 prepare the writings of Exhibit 502?</p> <p>3 A The ideas in 502 were prepared in 1984 and</p> <p>4 1985 -- between '84 and '86 I would say.</p> <p>5 Q How can you be sure?</p> <p>6 A It was during those -- it was during the time</p> <p>7 when I was taking all of my graduate courses.</p> <p>8 Q Were the pages of Exhibit 502 from a notebook</p> <p>9 of yours?</p> <p>10 A They were derived from a notebook, yes. Yes,</p> <p>11 sir.</p> <p>12 Q What do you mean "derived from a notebook"?</p> <p>13 A For example, figure 1 came from a sketch.</p> <p>14 Q Figure 1, what page?</p> <p>15 A Figure 1 of page 00192 of Exhibit 502.</p> <p>16 Q Did you prepare page 192 on a computer?</p> <p>17 A Yes, sir.</p> <p>18 Q Did you retain a copy of a printout of that</p> <p>19 computer as page 192?</p> <p>20 A When you say "printout," are you talking about</p> <p>21 the original printout from the computer that plotted</p> <p>22 it or --?</p> <p>23 Q Yes.</p> <p>24 A I believe I have the original copy, yes, sir.</p> <p>25 Q Is page 192 a copy of a printed page?</p>
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<p>1 is that correct?</p> <p>2 A That's correct, sir.</p> <p>3 Q Did you have assistance from anyone else?</p> <p>4 A Say that again.</p> <p>5 Q Did you have assistance from anyone else?</p> <p>6 A No, sir.</p> <p>7 Q When did you prepare Exhibit 502?</p> <p>8 A Are you talking about the time frame?</p> <p>9 Q Yes.</p> <p>10 A This documents were prepared, to the best of</p> <p>11 my knowledge, in early part of May.</p> <p>12 Q What year?</p> <p>13 A 2006.</p> <p>14 Q Why did you prepare these?</p> <p>15 A On the advice of my attorney.</p> <p>16 Q So prior to May 2006, Exhibit 502 did not</p> <p>17 exist?</p> <p>18 A They do exist.</p> <p>19 Q Let's step back. When did you prepare</p> <p>20 originally the pages of Exhibit 502?</p> <p>21 A No. I think we -- I think I misunderstood</p> <p>22 your earlier question. When you said "prepared," are</p> <p>23 you talking about producing the documents?</p> <p>24 Q Create the ideas on this page.</p> <p>25 A Oh, okay. Now I misunderstood your question.</p>	<p>1 A When you say -- what do you mean by "printed</p> <p>2 page"?</p> <p>3 Q When you were asked to produce page 192 of</p> <p>4 Exhibit 502, did you copy a printed page from your</p> <p>5 files, or did you print the page from some computer</p> <p>6 storage mechanism?</p> <p>7 A Do you mean at that time, back in '84, '86?</p> <p>8 Q In May 2006.</p> <p>9 A Oh, you're talking May 2006. I went to</p> <p>10 Kinko's and made copies of the originals.</p> <p>11 Q The originals were hard copies; is that</p> <p>12 correct?</p> <p>13 A That's correct, sir.</p> <p>14 Q Is that true of all the papers that you</p> <p>15 produced in this litigation?</p> <p>16 A The -- I have originals.</p> <p>17 Q Hard copies?</p> <p>18 A Yes, sir.</p> <p>19 Q And you had saved all the hard copies for over</p> <p>20 20 years; is that correct?</p> <p>21 A That's correct.</p> <p>22 Q Why did you save them all?</p> <p>23 A I save along with all my notes from as far</p> <p>24 back as I could in case if I ever need to refresh my</p> <p>25 memory.</p>

12 (Pages 42 to 45)

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Page 46	<p>1 Q Do you have any electronic copies of any of</p> <p>2 your work dating back to the early '80s?</p> <p>3 A Unfortunately, they were all destroyed.</p> <p>4 Q The source code that you produced in this</p> <p>5 litigation came from hard copies; is that correct?</p> <p>6 A I have the source code. I have both the hard</p> <p>7 copies and the electronic copy.</p> <p>8 Q So when you said that all the electronic</p> <p>9 copies were destroyed, what were you talking about?</p> <p>10 A I'm talking about the documents. I'm not</p> <p>11 talking about source codes.</p> <p>12 Q So for the source code you have electronic</p> <p>13 copies and hard copies; is that right?</p> <p>14 A That's correct, sir.</p> <p>15 Q Do you have any electronic copies of any other</p> <p>16 documents or other papers?</p> <p>17 A No, sir.</p> <p>18 Q When you produced the source code for this</p> <p>19 litigation, did you copy hard copies, or did you print</p> <p>20 out pages from your electronic copies?</p> <p>21 A I print out copies from my electronic copy.</p> <p>22 Q Do you have the original disks?</p> <p>23 A What do you mean by "original disks"?</p> <p>24 Q I'm sorry. Do you have the electronic copies</p> <p>25 stored somewhere?</p>	Page 48	<p>1 Q You have no doubt, though, that you may have</p> <p>2 signed something; right?</p> <p>3 A I don't recall signing any nondisclosure</p> <p>4 agreement.</p> <p>5 Q That wasn't the question. Do you have any</p> <p>6 doubt that you signed such an agreement regarding the</p> <p>7 intellectual property ownership?</p> <p>8 A Say that again.</p> <p>9 Q You don't -- do you have any doubt that you</p> <p>10 signed an agreement regarding intellectual property?</p> <p>11 A To the best of my knowledge, I did not sign an</p> <p>12 agreement.</p> <p>13 Q Did you sign any agreements with ICC when you</p> <p>14 became a consultant for ICC?</p> <p>15 A No, sir.</p> <p>16 Q None whatsoever?</p> <p>17 A Not to the best of my knowledge.</p> <p>18 Q Would you be surprised if it turns out that</p> <p>19 you did sign such an agreement?</p> <p>20 A I would be surprised.</p> <p>21 Q Did you sign any agreements with University of</p> <p>22 South Carolina when you were a graduate student?</p> <p>23 A I don't recall signing an agreement.</p> <p>24 Q Were you given any type of compensation while</p> <p>25 you were a graduate student from the University of</p>
Page 47	<p>1 A Yes, sir.</p> <p>2 Q Where are they stored?</p> <p>3 A On my computer in my office.</p> <p>4 Q In your office at your work?</p> <p>5 A That's correct, sir.</p> <p>6 Q University of -- I'm sorry, Florida State</p> <p>7 University?</p> <p>8 A That's correct, sir.</p> <p>9 Q Why do you have copies on your computer at</p> <p>10 work?</p> <p>11 A I always try to keep copies of my source code,</p> <p>12 because that is my property, my intellectual property.</p> <p>13 Q The source code was created in 1986; right?</p> <p>14 A That's correct, somewhere between '84 and '86.</p> <p>15 Q And you retained a copy?</p> <p>16 A That's correct.</p> <p>17 Q Did it belong to you?</p> <p>18 A I -- yes, sir.</p> <p>19 Q You didn't sign an agreement with the</p> <p>20 University of South Carolina that all intellectual</p> <p>21 property belonged to the university?</p> <p>22 A I don't recall that.</p> <p>23 Q You didn't sign an agreement with ICC that all</p> <p>24 intellectual property --</p> <p>25 A I don't recall that either.</p>	Page 49	<p>1 South Carolina?</p> <p>2 A The only compensation was a stipend.</p> <p>3 Q Did you understand that as a graduate student</p> <p>4 that you were an employee of the university?</p> <p>5 A I don't recall understanding that kind of</p> <p>6 employment back then.</p> <p>7 Q Did you understand that at the University of</p> <p>8 South Carolina it was their policy that any work that</p> <p>9 was performed using their resources was the property</p> <p>10 of University of South Carolina?</p> <p>11 A It's possible.</p> <p>12 Q So isn't it possible that the copies you</p> <p>13 retained in your computer in Florida State University</p> <p>14 are the property of University of South Carolina?</p> <p>15 A Possible.</p> <p>16 Q Just to be clear, the copies of the source</p> <p>17 code that you produced in this litigation are</p> <p>18 printouts from your computer in the Florida State</p> <p>19 University; is that right?</p> <p>20 A That's correct, sir.</p> <p>21 Q Do you have any other electronic copies of</p> <p>22 that source code?</p> <p>23 A What do you mean by "other electronic copies"?</p> <p>24 Q Other than on your computer at Florida State</p> <p>25 University?</p>

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<p>1 A Those are the only place I store them, sir.</p> <p>2 Q You don't have any personal copies at your</p> <p>3 home?</p> <p>4 A Well that is mine, I guess.</p> <p>5 Q I'm sorry. Turning back to Exhibit 502.</p> <p>6 A Okay.</p> <p>7 Q Do you know the date in which you created page</p> <p>8 0193?</p> <p>9 A To the best of my knowledge, this sketch was</p> <p>10 produced in either '84 or '85, in that area.</p> <p>11 Q Not '86?</p> <p>12 A Possible.</p> <p>13 Q Is it possible it was created in 1987?</p> <p>14 A No.</p> <p>15 Q Why is that?</p> <p>16 A In '87, most of the preliminary work has</p> <p>17 already been completed.</p> <p>18 Q You said that Dr. Kobayashi put a requirement</p> <p>19 on you to have a marketable product in 1987; isn't</p> <p>20 that correct?</p> <p>21 A That's correct, sir.</p> <p>22 Q Did you say that you completed that product?</p> <p>23 A I finish writing the code. However, it is not</p> <p>24 in a state where it's marketable.</p> <p>25 Q When did you finish writing the code?</p>	<p>1 A That's not true. That's not true.</p> <p>2 Q You said it wasn't well tested; right?</p> <p>3 A Well tested means -- it has been tested, but,</p> <p>4 you know, you could extensively test, and that's going</p> <p>5 to require a lot of time. And I never had the time to</p> <p>6 extensively test it.</p> <p>7 Q Why would you bother to extensively test it if</p> <p>8 you knew it was going to work anyway?</p> <p>9 A You can never be so sure of --</p> <p>10 Q So isn't it possible that, because of the</p> <p>11 testing, that the program had to be revised to make it</p> <p>12 marketable?</p> <p>13 A That's correct.</p> <p>14 Q So it is possible; right?</p> <p>15 A Possible on what?</p> <p>16 Q That someone would have to revise the program</p> <p>17 to make it marketable?</p> <p>18 MR. SU: Objection, speculation.</p> <p>19 A It is possible to further refine that program.</p> <p>20 BY MR. OLIVER:</p> <p>21 Q You have no knowledge whatsoever, however,</p> <p>22 that it was ever used in any commercial product; isn't</p> <p>23 that right?</p> <p>24 A Say that again.</p> <p>25 Q You have no knowledge whatsoever whether or</p>
Page 51	Page 53
<p>1 A The code was probably completed in '86.</p> <p>2 Q Do you know when in 1986?</p> <p>3 A I don't recall exactly.</p> <p>4 Q Do you know exactly when in 1987 Dr. Kobayashi</p> <p>5 made this requirement of you?</p> <p>6 A It was in early '87, spring of '87.</p> <p>7 Q Do you know if the product -- which I believe</p> <p>8 was in Neptune; is that correct?</p> <p>9 A Yes, sir.</p> <p>10 Q -- was further revised by others after you</p> <p>11 left?</p> <p>12 A I'm not aware of it.</p> <p>13 Q Would you be surprised if it was?</p> <p>14 A Yes. I would be a little bit surprised.</p> <p>15 Q If it wasn't marketable, why would you be so</p> <p>16 surprised that it was revised?</p> <p>17 A Say that again.</p> <p>18 Q If the product was at that time not</p> <p>19 marketable, why would you be so surprised that it was</p> <p>20 revised?</p> <p>21 A When I say "not marketable," I meant that</p> <p>22 program is not well documented. It has not been well</p> <p>23 tested to perform in the real environment.</p> <p>24 Q So as far as you know, it didn't work, because</p> <p>25 it hadn't been well tested?</p>	<p>1 not the Neptune program was ever used in any</p> <p>2 commercial product?</p> <p>3 A Not to my knowledge.</p> <p>4 Q As far as you know they could have used a</p> <p>5 completely different program; isn't that correct?</p> <p>6 A Say that again.</p> <p>7 Q As far as you know ICC could have used a</p> <p>8 completely different cell selector program?</p> <p>9 MR. SU: Objection as to form.</p> <p>10 A I seriously doubt it.</p> <p>11 BY MR. OLIVER:</p> <p>12 Q Why is that?</p> <p>13 A Because I have been working on the cell</p> <p>14 selection module, and nobody else that I know of has</p> <p>15 worked on that. And the cell selection module is the</p> <p>16 necessary module for the silicon compiling.</p> <p>17 Q What silicon compiler?</p> <p>18 A The knowledge-based silicon compiler.</p> <p>19 Q What is the knowledge-based silicone compiler?</p> <p>20 A That is the idea that I sketched in Exhibit --</p> <p>21 let me try to find it -- in Exhibit 503, page 00199.</p> <p>22 Q Did you coin the phrase, knowledge-based</p> <p>23 silicon compiler?</p> <p>24 A That's correct, sir.</p> <p>25 Q How did you coin that phrase?</p>

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<p>1 A It came from -- it is probably inspired by the</p> <p>2 courses I took in rule-based systems.</p> <p>3 Q No one else gave you the idea for that name?</p> <p>4 A That's correct.</p> <p>5 Q Dr. Kobayashi didn't come up with that name</p> <p>6 himself?</p> <p>7 A I don't recall it. I don't recall that he</p> <p>8 gave me any input in that title.</p> <p>9 Q Do you recall that he gave you -- that he came</p> <p>10 up with the idea?</p> <p>11 A No, no. I -- that was my original idea.</p> <p>12 Q Did you document the idea?</p> <p>13 A The only document I have is this hand-sketched</p> <p>14 diagram.</p> <p>15 Q When did you create this hand-sketched diagram</p> <p>16 which is Exhibit 503, page 199?</p> <p>17 A I believe, to the best of my knowledge, this</p> <p>18 sketch was made in 1985.</p> <p>19 Q Did you come up with all the idea reflected in</p> <p>20 this page 199?</p> <p>21 A When -- what do you mean by "all of the</p> <p>22 ideas"?</p> <p>23 Q Did you, for example, come up with the idea of</p> <p>24 using the AAF language?</p> <p>25 A I am not the inventor of AAF language.</p>	<p>1 Q No other pages of Exhibit 503 reflect the KBSC</p> <p>2 system; is that correct?</p> <p>3 A (Examining document). To the best of my</p> <p>4 knowledge, I do not have any other documentation that</p> <p>5 has the title "knowledge-based silicon compiler" in my</p> <p>6 possession, except this page 00199 on Exhibit 503.</p> <p>7 Q Did you show this sketch to anyone?</p> <p>8 A Yes, sir.</p> <p>9 Q Who did you show it to?</p> <p>10 A I showed it to my counsel.</p> <p>11 Q In early 1990 -- in early 1985 or any time</p> <p>12 around early 1985, did you show this sketch to anyone?</p> <p>13 A Yes, sir.</p> <p>14 Q Who did you show it to?</p> <p>15 A I -- I may have showed it to my advisor,</p> <p>16 Dr. Kobayashi.</p> <p>17 Q When?</p> <p>18 A My estimate would be 1985.</p> <p>19 Q Do you have a clear recollection of showing it</p> <p>20 to Dr. Kobayashi?</p> <p>21 A I always meet with him once or twice a week.</p> <p>22 Q Do you show him everything you do?</p> <p>23 A I would say most of the work I did.</p> <p>24 Q Do you have any record of showing</p> <p>25 Dr. Kobayashi?</p>
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<p>1 Q Did you know to use the AAF for the KBSC</p> <p>2 system?</p> <p>3 A Yes.</p> <p>4 Q That was your idea?</p> <p>5 A The AAF already existed.</p> <p>6 Q The use of the AAF in the KBSC did not exist</p> <p>7 prior to your idea; isn't that correct?</p> <p>8 A All I can say is that this configuration, this</p> <p>9 system was my original idea.</p> <p>10 Q Everything on this page 199 was your idea</p> <p>11 alone; is that correct?</p> <p>12 A That's correct, sir.</p> <p>13 Q Did you ever apply for a patent on this idea?</p> <p>14 A No, sir.</p> <p>15 Q Why is that?</p> <p>16 A I'm not aware of what a patent is at that</p> <p>17 time, sir.</p> <p>18 Q Do you know exactly when in 1985 you came up</p> <p>19 with this sketch, 199?</p> <p>20 A My estimate would be the early part of 1985.</p> <p>21 Q And you have no other documentation that</p> <p>22 reflects your idea regarding the KBSC system; is that</p> <p>23 correct?</p> <p>24 A To the best of my knowledge, I don't have any</p> <p>25 of those.</p>	<p>1 A No, sir.</p> <p>2 Q Did you show it to anyone else?</p> <p>3 A No, sir.</p> <p>4 Q Why not?</p> <p>5 A There is no reason to.</p> <p>6 Q Why?</p> <p>7 A Who would I show it to?</p> <p>8 Q I don't know. Dr. Bonnell?</p> <p>9 A No, sir.</p> <p>10 Q Wouldn't Dr. Bonnell fully appreciate having a</p> <p>11 rule-based system applied to VLSI?</p> <p>12 A No, sir.</p> <p>13 Q He wouldn't? Why is that?</p> <p>14 A He was not really interested in VLSI, to the</p> <p>15 best of my knowledge.</p> <p>16 Q He's interested in rule-based systems; isn't</p> <p>17 that correct?</p> <p>18 A That's correct.</p> <p>19 Q In fact, you used a rule-based system in VLSI</p> <p>20 for his class project; right?</p> <p>21 A That's correct.</p> <p>22 Q Wouldn't this be a follow-up to your class</p> <p>23 project?</p> <p>24 A Somewhat, yes.</p> <p>25 Q You're not saying that Exhibit 503, page 199,</p>

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<p>1 was your class project; are you?</p> <p>2 A Are you talking about this particular page,</p> <p>3 00199?</p> <p>4 Q Yes. Yes.</p> <p>5 A To the best of my recollection, I -- this is</p> <p>6 just a sketch. I have no idea what the final product</p> <p>7 is for the class project.</p> <p>8 Q How did you come up with this sketch?</p> <p>9 A It actually evolved. You can see in the top</p> <p>10 part of the page, I have a computer-generated diagram</p> <p>11 that I made. And then later I made some corrections</p> <p>12 on it, and then I revised it. And you can see my</p> <p>13 hand-sketched notes through the evolution of the</p> <p>14 design.</p> <p>15 Q What problem were you trying to solve at the</p> <p>16 time?</p> <p>17 A The problem I'm trying to solve is to</p> <p>18 translate a behavioral language description into</p> <p>19 silicon.</p> <p>20 Q Where did you get that idea?</p> <p>21 A The idea was inspired by the courses that I</p> <p>22 took.</p> <p>23 Q I'm sorry. Where did you get the appreciation</p> <p>24 for that problem?</p> <p>25 A This project was inspired by the courses that</p>	<p>1 one of them is called EDN.</p> <p>2 Q Is there a particular article in EDN that --</p> <p>3 A I don't recall a particular issue. It was in</p> <p>4 1984, '85 time frame.</p> <p>5 Q Did you publish any papers that describe the</p> <p>6 KBSC system?</p> <p>7 A Indirectly, yes.</p> <p>8 Q What did you publish?</p> <p>9 A The paper on the knowledge-based VLSI cell</p> <p>10 selection paper.</p> <p>11 Q The paper with Dr. Kobayashi?</p> <p>12 A That's correct, sir.</p> <p>13 Q Handing you what has been marked as Exhibit</p> <p>14 508, bearing production number KBSC 00914 through</p> <p>15 0917. Is Exhibit 508 the "Knowledge-Based System For</p> <p>16 VLSI Module Selection" paper that you are describing?</p> <p>17 A Say that again, sir.</p> <p>18 Q Is Exhibit 508 the paper that you are</p> <p>19 describing?</p> <p>20 A That's correct, sir.</p> <p>21 Q Other than this paper of Exhibit 508, was</p> <p>22 there any other paper that described the KBSC system</p> <p>23 you sketched on Exhibit 503?</p> <p>24 A Another paper is the "A Framework For Managing</p> <p>25 VLSI CAD Data."</p>
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<p>1 I took.</p> <p>2 Q Do you know what courses inspired you?</p> <p>3 A To the best of my recollection, those are the</p> <p>4 courses that were -- that I took under Professor</p> <p>5 Bonnell, and there was a one VLSI course that I took</p> <p>6 under Dr. Peeples.</p> <p>7 Q Who is Dr. Peeples?</p> <p>8 A Dr. Peeples is an adjunct professor from NCR</p> <p>9 at that time.</p> <p>10 Q What, in his course, inspired you to solve the</p> <p>11 problem of translating behavioral language description</p> <p>12 into silicon?</p> <p>13 A Dr. Peeples taught me the basics of</p> <p>14 transistors and integrated circuits, and Professor</p> <p>15 Bonnell taught me the rule-based systems and</p> <p>16 artificial intelligence.</p> <p>17 Q How did you even know there were different</p> <p>18 abstract levels of input design for a system?</p> <p>19 A It could be based on the papers that I have</p> <p>20 read.</p> <p>21 Q What papers did you read?</p> <p>22 A At that time I used to go to the library and</p> <p>23 read up on the VLSI design.</p> <p>24 Q Can you identify any papers today?</p> <p>25 A Some of the journals or magazines that I read,</p>	<p>1 Q Handing you what has been marked as Exhibit</p> <p>2 509, bearing production numbers KBSC 000904 through</p> <p>3 0913. Is Exhibit 509 the framework paper you just</p> <p>4 discussed?</p> <p>5 A That's correct, sir.</p> <p>6 (Exhibit No. 509 was identified for the</p> <p>7 record).</p> <p>8 BY MR. OLIVER:</p> <p>9 Q Other than Exhibit 508 and 509, are there any</p> <p>10 other papers that describe KBSC system of Exhibit 503?</p> <p>11 A Yes, sir.</p> <p>12 Q What papers?</p> <p>13 A There was another unpublished manuscript.</p> <p>14 Q Handing you what has been marked Exhibit 510,</p> <p>15 bearing production number FOO 000239 through 0255. Is</p> <p>16 Exhibit 510 an unpublished manuscript that you just</p> <p>17 discussed?</p> <p>18 A That's correct, sir.</p> <p>19 (Exhibit No. 510 was identified for the</p> <p>20 record).</p> <p>21 BY MR. OLIVER:</p> <p>22 Q Other than Exhibits 508, 509 and 510, are</p> <p>23 there any papers that describe the KBSC system of</p> <p>24 Exhibit 503?</p> <p>25 A To the best of my knowledge, there is no other</p>

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Page 62	<p>1 papers.</p> <p>2 Q All of the papers in Exhibits 508, 509 and 510</p> <p>3 have Dr. Kobayashi as coauthor; isn't that correct?</p> <p>4 A That's correct, sir.</p> <p>5 Q Why is that?</p> <p>6 A The reason is, he is my advisor.</p> <p>7 Q Is it customary to have your advisor placed on</p> <p>8 your publications?</p> <p>9 A That's correct, sir.</p> <p>10 Q Do you believe Dr. Kobayashi contributed ideas</p> <p>11 to the papers of Exhibits 508, 509 and 510?</p> <p>12 A What do you mean by "ideas"?</p> <p>13 Q Anything that's reflected in Exhibits 508</p> <p>14 through 510.</p> <p>15 A Again, can I clarify, what do you mean by</p> <p>16 "ideas"?</p> <p>17 Q Do you have any understanding of the term</p> <p>18 "ideas"?</p> <p>19 A Ideas about the paper?</p> <p>20 Q Anything. Was there any contribution by</p> <p>21 Dr. Kobayashi, for example, in writing Exhibit 508?</p> <p>22 A He helped me with the grammar and the</p> <p>23 technical writing skills.</p> <p>24 Q Was that his only contribution?</p> <p>25 A I believe so.</p>	Page 64	<p>1 A Again, like I mentioned, Kobayashi is the</p> <p>2 founder of this company, and since he's my advisor, he</p> <p>3 has a prerogative to, you know, to put -- to list</p> <p>4 whoever, you know, whoever the sponsor is.</p> <p>5 Q Were you a graduate student at the time that</p> <p>6 you wrote this paper of Exhibit 508?</p> <p>7 A That's correct, sir.</p> <p>8 Q Were you a graduate student when you came up</p> <p>9 with the idea for Exhibit 503?</p> <p>10 A I was a graduate student, sir.</p> <p>11 Q When you're a graduate student, don't you work</p> <p>12 on projects that are sponsored by either the</p> <p>13 university or an industry?</p> <p>14 A That's correct.</p> <p>15 Q Do you ever work on projects that are not</p> <p>16 sponsored?</p> <p>17 A That's correct, sir.</p> <p>18 Q Was the KBSC system a project that was</p> <p>19 sponsored?</p> <p>20 A I'm not aware of the sponsorship.</p> <p>21 Q There could have been sponsors; is that</p> <p>22 correct?</p> <p>23 A It could be.</p> <p>24 Q How does the sponsorship work?</p> <p>25 A Sponsorship means there is monetary funds</p>
Page 63	<p>1 Q He did not provide you with any technical</p> <p>2 input?</p> <p>3 A Not that I know of.</p> <p>4 Q Did he provide any technical input for</p> <p>5 Exhibits 509 or 510?</p> <p>6 A No, sir.</p> <p>7 Q Exhibit 508 indicates on page 0914 that the</p> <p>8 work was supported by International Chip Corporation;</p> <p>9 is that correct?</p> <p>10 A That is correct. And that is what he wanted</p> <p>11 me to put it down in the paper.</p> <p>12 Q Is it not true?</p> <p>13 A I did not say it's not true. I said that's</p> <p>14 what he wanted to be on the paper.</p> <p>15 Q Was the work in Exhibit 508 supported by ICC?</p> <p>16 A Not totally.</p> <p>17 Q In any respect?</p> <p>18 A Partially, yes.</p> <p>19 Q How was it supported by ICC?</p> <p>20 A I -- to the best of my knowledge, because</p> <p>21 Kobayashi, who is my advisor, is also the -- I guess</p> <p>22 the founder of ICC, he could have put the company</p> <p>23 as -- as part of the sponsor. Again, it is not my</p> <p>24 intention to put the name of the company.</p> <p>25 Q What do you mean "sponsor"?</p>	Page 65	<p>1 involved, according to my knowledge.</p> <p>2 Q That's where the stipend comes in; is that</p> <p>3 right?</p> <p>4 A The stipend was through the college of</p> <p>5 engineering, sir.</p> <p>6 Q You're not paid through the sponsorship?</p> <p>7 A Not to my knowledge.</p> <p>8 Q Not directly?</p> <p>9 A Not to the best of my knowledge.</p> <p>10 Q When you created the KBSC system of Exhibit</p> <p>11 503, did you use any university resources?</p> <p>12 A Yes, sir.</p> <p>13 Q What did you use?</p> <p>14 A The computer.</p> <p>15 Q Anything else?</p> <p>16 A The paper.</p> <p>17 Q Did you develop the KBSC system at the</p> <p>18 university?</p> <p>19 A That's correct, sir.</p> <p>20 Q Did you have a working prototype?</p> <p>21 A It was a paper design, sir.</p> <p>22 Q You never had a prototype?</p> <p>23 A Prototype of what?</p> <p>24 Q The KBSC system that you have in Exhibit 503.</p> <p>25 A Are you talking about the entire system?</p>

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<p>1 Q Yes.</p> <p>2 A I don't have the entire system, sir.</p> <p>3 Q You invented it; right?</p> <p>4 A The idea was mine.</p> <p>5 Q The entire system; right?</p> <p>6 A The -- what is on this page was my original</p> <p>7 idea.</p> <p>8 Q What is the output of what's on this page?</p> <p>9 A It goes to the module placement and routing.</p> <p>10 Q What is a module?</p> <p>11 A Which is a cell.</p> <p>12 Q What is a cell?</p> <p>13 A The integrated circuits building blocks.</p> <p>14 Q Do you define that on the page?</p> <p>15 A It is understood, sir.</p> <p>16 Q How is it understood from the page?</p> <p>17 A This sketch is for my own use.</p> <p>18 Q Did you ever develop any portion of your KBSC</p> <p>19 system?</p> <p>20 MR. SU: Object as to form.</p> <p>21 A Say that again, sir.</p> <p>22 BY MR. OLIVER:</p> <p>23 Q Did you ever develop any portion of the KBSC</p> <p>24 system shown in Exhibit 503?</p> <p>25 A Yes, sir.</p>	<p>1 Q I would like you to just explain what type of</p> <p>2 expertise was put in the knowledge base of Exhibit</p> <p>3 503.</p> <p>4 A The expertise is the expertise from the IC</p> <p>5 designer.</p> <p>6 Q What type of expertise?</p> <p>7 A For example, the power dissipation, the</p> <p>8 propagation delay and the area of the cell.</p> <p>9 Q How is that expertise?</p> <p>10 A That is not just the only expertise. You</p> <p>11 know, there are other expertise involved --</p> <p>12 Q At the time you created Exhibit 503, what type</p> <p>13 of expertise was in the knowledge base?</p> <p>14 A The expertise is -- for example, a particular</p> <p>15 function could be implemented in a number of ways, and</p> <p>16 each way has some trade-off. And the question is, you</p> <p>17 know, how do you pick which one to get optimum</p> <p>18 performance.</p> <p>19 Q Can you give us an example?</p> <p>20 A An example would be an adder. We can have a</p> <p>21 ripple adder, which takes up a lot of space and is</p> <p>22 very slow, and you can have a faster adder, like a</p> <p>23 carry safe adder, but it takes up a lot of space and</p> <p>24 is much harder to design.</p> <p>25 Q Is there any other rules -- I'm sorry,</p>
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<p>1 Q What portion?</p> <p>2 A I believe I developed the parser and the</p> <p>3 module selection and the knowledge base.</p> <p>4 Q How did you develop the knowledge base?</p> <p>5 A It is based on an expertise that's an IC</p> <p>6 designer.</p> <p>7 Q Are you an IC designer?</p> <p>8 A Yes, sir.</p> <p>9 Q So it was your own expertise?</p> <p>10 A That's correct, sir.</p> <p>11 Q Did you have any expertise from anyone else?</p> <p>12 A I could use somebody else's I expect.</p> <p>13 Q Did you?</p> <p>14 A No, I did not, sir.</p> <p>15 Q What type of expertise did you have in the</p> <p>16 system?</p> <p>17 A What system are you referring to?</p> <p>18 Q The system of Exhibit 503.</p> <p>19 A Could you elaborate more? What expertise are</p> <p>20 you referring to?</p> <p>21 Q You said you used expertise of your own in the</p> <p>22 system. What expertise did you put in the system?</p> <p>23 MR. SU: Objection, misstates prior testimony.</p> <p>24 A I don't understand your question, sir.</p> <p>25 BY MR. OLIVER:</p>	<p>1 expertise?</p> <p>2 A There are other expertise.</p> <p>3 Q What other expertise?</p> <p>4 A Expertise on the database, on the knowledge</p> <p>5 base?</p> <p>6 Q Yes.</p> <p>7 A I believe those are the predominant ones.</p> <p>8 Q Any others that you know of?</p> <p>9 A Not that I know of.</p> <p>10 Q Did you have this expertise in mind when you</p> <p>11 created the hand sketch of Exhibit 503?</p> <p>12 A Yes, sir.</p> <p>13 Q Simultaneously with the hand sketch?</p> <p>14 A Yes, sir.</p> <p>15 Q What year did you say you drew this?</p> <p>16 A I believe this was drawn in early 1985.</p> <p>17 Q How can you be sure?</p> <p>18 A That is just my estimate, based on the courses</p> <p>19 I have taken at that time.</p> <p>20 Q Did you keep a lab notebook?</p> <p>21 A My lab notebook are basically my sketches like</p> <p>22 this.</p> <p>23 Q Was this sketch of Exhibit 503 bound in a</p> <p>24 notebook?</p> <p>25 A No, sir.</p>

18 (Pages 66 to 69)

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<p>1 Q Was it just loose?</p> <p>2 A Yes, sir.</p> <p>3 Q Was it in a folder?</p> <p>4 A That's correct, sir.</p> <p>5 Q What type of folder?</p> <p>6 A It's like a manilla folder.</p> <p>7 Q Did the manilla folder have a label?</p> <p>8 A Say that again.</p> <p>9 Q Did the folder have a label?</p> <p>10 A Probably, yes.</p> <p>11 Q What did the label say?</p> <p>12 A Probably the label would say, knowledge-based</p> <p>13 system, something like that.</p> <p>14 Q You didn't produce the folder.</p> <p>15 A The folders probably are lost.</p> <p>16 Q So when you retrieved this document, was it in</p> <p>17 a folder at the time?</p> <p>18 A No. It was not in a folder. It was loose.</p> <p>19 Now the fold every was -- at that time, you are</p> <p>20 talking about some 20 years ago. But in the process</p> <p>21 of moving and, you know --.</p> <p>22 Q You did not get the KBSC system -- strike</p> <p>23 that. You did not get the idea for the KBSC system</p> <p>24 from Dr. Kobayashi; is that your testimony?</p> <p>25 A That's correct, sir.</p>	<p>1 that correct?</p> <p>2 A That's correct, sir.</p> <p>3 Q What did you do as a consultant?</p> <p>4 A I wrote -- I advise on what needs to be --</p> <p>5 what is needed to make a knowledge-based, you know,</p> <p>6 component.</p> <p>7 Q What did you do?</p> <p>8 A My specific task that was assigned to me is</p> <p>9 the module selection.</p> <p>10 Q Do you know what the company was working on at</p> <p>11 the time?</p> <p>12 A At that time I was just a graduate student,</p> <p>13 and I'm not involved in the administrative work.</p> <p>14 Q Do you know if your module selector was part</p> <p>15 of a bigger system?</p> <p>16 A Yes, possible.</p> <p>17 Q What was the bigger system?</p> <p>18 A It was to a compiler.</p> <p>19 Q Did you know it was a knowledge-based</p> <p>20 compiler?</p> <p>21 A I'm not sure what -- I believe it was based on</p> <p>22 my paper that Dr. Kobayashi and I published.</p> <p>23 Q So you went to work for a company; you were</p> <p>24 asked to write a small portion of a system that you</p> <p>25 created; isn't that right?</p>
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<p>1 Q Do you have any doubt on that?</p> <p>2 A No, I don't have any doubt on that.</p> <p>3 Q How can you be so sure?</p> <p>4 A To the best of my knowledge, that is my</p> <p>5 original work, sir.</p> <p>6 Q You met with him weekly; right?</p> <p>7 A That's correct.</p> <p>8 Q You discussed all the topics?</p> <p>9 A I don't discuss everything.</p> <p>10 Q Did he ever discuss his work with you?</p> <p>11 A What work are you talking about? What work</p> <p>12 are you referring?</p> <p>13 Q I don't know. Did he ever discuss any of his</p> <p>14 work with you?</p> <p>15 A Yes, some work.</p> <p>16 Q Did he discuss any rule-based systems with</p> <p>17 you?</p> <p>18 A No.</p> <p>19 Q Ever?</p> <p>20 A No.</p> <p>21 Q Not even during your work at ICC?</p> <p>22 A The discussion on the knowledge-based systems</p> <p>23 was after we published these papers, which is Exhibit</p> <p>24 508.</p> <p>25 Q You worked as a consultant in 1986 for ICC; is</p>	<p>1 A That's correct, yes.</p> <p>2 Q And you didn't say anything to Dr. Kobayashi</p> <p>3 at that time that --</p> <p>4 A I would not question him, sir.</p> <p>5 Q But you realize that he was working on your</p> <p>6 system; right?</p> <p>7 A That's correct, sir, yes.</p> <p>8 Q And you didn't say anything?</p> <p>9 A No, I would not say anything.</p> <p>10 Q You didn't demand any compensation for that?</p> <p>11 A No.</p> <p>12 Q Did you tell anybody else that this was your</p> <p>13 idea?</p> <p>14 A No, I did not.</p> <p>15 Q You didn't tell Mr. Ozeki?</p> <p>16 A He kind of know -- kind of knew what I was</p> <p>17 working on.</p> <p>18 Q So he knew about the KBSC system?</p> <p>19 A I would not -- I would not say that he knew</p> <p>20 intimately about --</p> <p>21 Q You were roommates; right?</p> <p>22 A That's correct.</p> <p>23 Q How long were you roommates?</p> <p>24 A We were roommates for, to the best of my</p> <p>25 recollection, two or three years.</p>

19 (Pages 70 to 73)

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<p>1 Q What years?</p> <p>2 A I believe starting in -- to the best of my</p> <p>3 recollection, starting in the fall of '84 until '88.</p> <p>4 Q What type of apartment did you have?</p> <p>5 A It was a two-bedroom apartment.</p> <p>6 Q Where was it?</p> <p>7 A Where?</p> <p>8 Q Yeah.</p> <p>9 A The name of the apartment was called River</p> <p>10 Bend Apartments in West Columbia.</p> <p>11 Q You never showed him your idea for the KBSC</p> <p>12 system?</p> <p>13 A I do not recall, sir.</p> <p>14 Q He worked at ICC too; right?</p> <p>15 A That's correct.</p> <p>16 Q He got you the job there; right?</p> <p>17 A He's not a person who got me the job there.</p> <p>18 Q Who got you the job?</p> <p>19 A It was Kobayashi.</p> <p>20 Q Did you get him the job there?</p> <p>21 A I do not recall.</p> <p>22 Q But you never mentioned to Ozeki or anyone</p> <p>23 that the KBSC system that ICC was working on is your</p> <p>24 idea?</p> <p>25 A I would not -- I'm not that kind of person who</p>	<p>1 MR. OLIVER: Want to take a break?</p> <p>2 (Short recess).</p> <p>3 BY MR. OLIVER:</p> <p>4 Q Back on the record. Would you turn back to</p> <p>5 Exhibit 502.</p> <p>6 A (Witness complies). Okay.</p> <p>7 Q On page 0192, which is the first page of</p> <p>8 Exhibit 502, you have a caption, figure 1,</p> <p>9 architecture of KBMS. What is KBMS?</p> <p>10 A Knowledge-based management system.</p> <p>11 Q It doesn't say silicone compiler there; right?</p> <p>12 A No.</p> <p>13 Q Why is that?</p> <p>14 A Sorry, sorry. Let me take it back. It is not</p> <p>15 knowledge-based management system. It's</p> <p>16 knowledge-based module selection.</p> <p>17 Q Does figure 1 of this exhibit depict the KBSC</p> <p>18 system?</p> <p>19 A Part of it.</p> <p>20 Q What part is missing?</p> <p>21 A Missing are routing, the netless generator.</p> <p>22 Q Had you conceived of those elements that are</p> <p>23 missing at the time that you wrote or created Exhibit</p> <p>24 502, page 192?</p> <p>25 A Say that again.</p>
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<p>1 would boast what I did.</p> <p>2 Q Were you flabbergasted when you found out they</p> <p>3 were working on your system?</p> <p>4 A Who was working on my system?</p> <p>5 Q ICC.</p> <p>6 A Well I would not question that.</p> <p>7 Q But yet you questioned it when you found out</p> <p>8 just recently that there was a paper that described</p> <p>9 the KBSC system; right?</p> <p>10 A That's correct, without my name on it, that's</p> <p>11 correct.</p> <p>12 Q Right. Well your name was nowhere in the ICC</p> <p>13 literature as the system belonging to you; right?</p> <p>14 MR. SU: Objection as to form.</p> <p>15 A I do not recall that, sir.</p> <p>16 BY MR. OLIVER:</p> <p>17 Q You didn't receive any compensation for</p> <p>18 inventing the system; right?</p> <p>19 A No, I did not.</p> <p>20 Q You didn't ask for any compensation; right?</p> <p>21 A No. At that time I was more concerned about</p> <p>22 graduation.</p> <p>23 Q You didn't leave ICC because of their use of</p> <p>24 your system?</p> <p>25 A No.</p>	<p>1 Q Had you created those missing elements at the</p> <p>2 time you created page 192?</p> <p>3 A To the best of my knowledge, this figure here</p> <p>4 came first, before a figure of -- sorry. Let me</p> <p>5 clarify this. To the best of my knowledge, figure 1</p> <p>6 of page 00192 of Exhibit 502 came first, before the</p> <p>7 first page of Exhibit 503, which is page 00199.</p> <p>8 Q Exhibits 502 through 506 are all hand drawing</p> <p>9 pages authored by you; is that correct?</p> <p>10 A That's correct, sir.</p> <p>11 Q Had you ever shown any of these pages to</p> <p>12 anyone else?</p> <p>13 A The only person I may have shown them is my</p> <p>14 advisor at that time, Dr. Kobayashi.</p> <p>15 Q And what time frame are we talking about?</p> <p>16 A We're talking about '84 through '86.</p> <p>17 Q All of the pages of Exhibits 502 through 506</p> <p>18 were created in the time frame 1984 through 1986; is</p> <p>19 that correct?</p> <p>20 A Let me look at -- you say Exhibits 502</p> <p>21 through --?</p> <p>22 Q 506.</p> <p>23 A -- through 506?</p> <p>24 Q These are all the hand drawing pages, or</p> <p>25 primarily hand drawing?</p>

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<p>1 A What was your question again?</p> <p>2 Q All of the pages of Exhibits 502 through 506</p> <p>3 were created during the time frame 1984 through 1986;</p> <p>4 is that correct?</p> <p>5 A That's correct.</p> <p>6 Q How can you be so sure of the time frame?</p> <p>7 A The reason I can be so sure is because it was</p> <p>8 during that time that I was a -- was a graduate</p> <p>9 student of Dr. Kobayashi.</p> <p>10 Q How do you know none of the pages were created</p> <p>11 after 1986?</p> <p>12 A It is possible that some pages may be created</p> <p>13 in '87.</p> <p>14 Q Not 1988 or after?</p> <p>15 A No, no.</p> <p>16 Q Didn't you publish a paper in 1990 directed to</p> <p>17 cell selection?</p> <p>18 A That's correct.</p> <p>19 Q Did you do work in 1990 for cell selection?</p> <p>20 A No, no.</p> <p>21 Q How did you come to create a paper in 1990 --</p> <p>22 A There was a manuscript that has not been</p> <p>23 published.</p> <p>24 Q Prior to that time?</p> <p>25 A That's right.</p>	<p>1 A I don't recall.</p> <p>2 Q The paper in 1990 dealt with cell selection</p> <p>3 but did not have Dr. Kobayashi's name; is that</p> <p>4 correct?</p> <p>5 A Say that again.</p> <p>6 Q The paper you published in 1990 dealt with</p> <p>7 cell selection, but did not --</p> <p>8 A That's correct.</p> <p>9 Q -- include as coauthor Dr. Kobayashi; isn't</p> <p>10 that correct?</p> <p>11 A That's correct, sir.</p> <p>12 Q In fact, you don't reference any of his</p> <p>13 papers; isn't that correct?</p> <p>14 A I don't recall, since I don't have a copy of</p> <p>15 that paper.</p> <p>16 Q Handing you what has been marked as Exhibit</p> <p>17 507, bearing production numbers FOO 000408 through</p> <p>18 0420. Is Exhibit 507 the paper that we've been</p> <p>19 discussing that was published in 1990?</p> <p>20 A That's correct.</p> <p>21 (Exhibit No. 507 was identified for the</p> <p>22 record).</p> <p>23 BY MR. OLIVER:</p> <p>24 Q Exhibit 507 has a lot of the same material</p> <p>25 that appears in the unpublished paper coauthored by</p>
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<p>1 Q Was it based on work you did with</p> <p>2 Dr. Kobayashi?</p> <p>3 A It was somewhat related, but it was not his</p> <p>4 idea.</p> <p>5 Q Didn't you attempt to publish a paper with a</p> <p>6 Dr. Takefuji in which the university required you</p> <p>7 withdraw that potential publication?</p> <p>8 A That's correct, sir.</p> <p>9 Q What was the name of that publication?</p> <p>10 A I don't recall.</p> <p>11 Q Do you recall the circumstances of that</p> <p>12 publication, potential publication?</p> <p>13 A I don't recall.</p> <p>14 Q But you do recall that it was withdrawn;</p> <p>15 right?</p> <p>16 A That's correct, yes.</p> <p>17 Q Did it deal with cell selection?</p> <p>18 A I don't recall.</p> <p>19 Q Do you know if it dealt with the KBSC system?</p> <p>20 A I don't recall, either.</p> <p>21 Q Do you know why it was withdrawn?</p> <p>22 A I believe it was withdrawn because Takefuji's</p> <p>23 name was on it, and Kobayashi's was not on it.</p> <p>24 Q Was that the same paper that you later</p> <p>25 published in 1990?</p>	<p>1 Dr. Kobayashi, which is marked as Exhibit 510; isn't</p> <p>2 that correct?</p> <p>3 A That's correct.</p> <p>4 Q Why did you leave Dr. Kobayashi off of Exhibit</p> <p>5 507?</p> <p>6 A He was not my advisor anymore.</p> <p>7 Q He did not contribute anything to the work</p> <p>8 described in 507?</p> <p>9 A I don't believe so.</p> <p>10 Q Are you saying he didn't describe -- he did</p> <p>11 not perform any contribution to Exhibit 510?</p> <p>12 A To the best of my knowledge, I was the person</p> <p>13 who wrote that paper.</p> <p>14 Q He did not provide any ideas?</p> <p>15 A To the best of my knowledge, no, sir.</p> <p>16 Q Isn't it possible that he did contribute</p> <p>17 ideas, you just don't remember?</p> <p>18 A I do not recall.</p> <p>19 Q In Exhibit 510 you cited two articles authored</p> <p>20 by you and Dr. Kobayashi; isn't that right? I will</p> <p>21 direct you to page 0250 of Exhibit 510.</p> <p>22 A That's correct.</p> <p>23 Q Those papers, however, were not referenced in</p> <p>24 Exhibit 507, the paper that was issued in 1990; isn't</p> <p>25 that correct?</p>

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<p>1 A That's correct.</p> <p>2 Q Why is that?</p> <p>3 A It could be -- I do not recall what was the</p> <p>4 reason.</p> <p>5 Q Is it possible you didn't want to include</p> <p>6 Dr. Kobayashi in this paper of 507?</p> <p>7 A I do not recall, sir.</p> <p>8 Q Would you turn back to Exhibit 502.</p> <p>9 A (Witness complies). Okay.</p> <p>10 Q What is the term "Saturn" as it's used on page</p> <p>11 196 of Exhibit 502?</p> <p>12 A Say that question again.</p> <p>13 Q What is the term "Saturn" as it appears on</p> <p>14 page 196?</p> <p>15 A To the best of my knowledge, Saturn was the</p> <p>16 name of this parser compiler that I was developing.</p> <p>17 Q What is referenced by the term rule 1, rule 2</p> <p>18 and rule 3 of page 196?</p> <p>19 A Those rules came from the controller. Most</p> <p>20 likely it's a traffic controller.</p> <p>21 Q Are those expert rules?</p> <p>22 A Those are just rules that describe the</p> <p>23 behavior of the controller.</p> <p>24 Q Are those the expert rules that you have in</p> <p>25 your knowledge base?</p>	<p>1 Q Was the Neptune knowledge base technology</p> <p>2 specific?</p> <p>3 A No, sir.</p> <p>4 Q Was it ever technology specific?</p> <p>5 A No, sir.</p> <p>6 Q Why is that?</p> <p>7 A It is designed to be general enough that it is</p> <p>8 technology independent.</p> <p>9 Q Is that true of all of your work, your base</p> <p>10 work?</p> <p>11 A I try to.</p> <p>12 Q Is that an advantage?</p> <p>13 A Yes.</p> <p>14 Q Why?</p> <p>15 A So that it can be ported in any environment.</p> <p>16 Q How do you meet delay and area constraints if</p> <p>17 they're not technology specific?</p> <p>18 A Say that question again.</p> <p>19 Q How do you meet delay and area constraints for</p> <p>20 a user's design if your database is not technology</p> <p>21 specific?</p> <p>22 A You have to store information according to the</p> <p>23 different types of technology.</p> <p>24 Q Is that information stored in Neptune?</p> <p>25 A You can store information about a particular</p>
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<p>1 A No, sir.</p> <p>2 Q What type of rules are they?</p> <p>3 A These rules, as on page 00196 of Exhibit 502,</p> <p>4 are rules that describe the behavior of the</p> <p>5 controller.</p> <p>6 Q Those rules do not incorporate expert</p> <p>7 knowledge; is that correct?</p> <p>8 A That's correct, sir.</p> <p>9 Q What is the reference to Neptune on page 198?</p> <p>10 A Say that question again.</p> <p>11 Q What is the reference to the term "Neptune" on</p> <p>12 page 198?</p> <p>13 A Neptune is the frame base knowledge base.</p> <p>14 Q On the bottom of the page it says, knowledge</p> <p>15 base of Neptune. There are four lines of source code.</p> <p>16 Do you see that?</p> <p>17 A That's correct.</p> <p>18 Q What is being performed by that source code?</p> <p>19 A Those line of code basically store information</p> <p>20 about a particular logic gate.</p> <p>21 Q What type of logic gate?</p> <p>22 A And I believe this is a and gate -- sorry,</p> <p>23 nand gate.</p> <p>24 Q Is it a technology-specific gate?</p> <p>25 A No, it's not technology specific.</p>	<p>1 technology, yes.</p> <p>2 Q But your work was technology independent?</p> <p>3 A That's right.</p> <p>4 Q Did you have expert rules in your Neptune?</p> <p>5 A I believe so.</p> <p>6 Q Were there expert rules anywhere else in your</p> <p>7 system?</p> <p>8 MR. SU: Objection as to form.</p> <p>9 A Could you clarify that question again?</p> <p>10 BY MR. OLIVER:</p> <p>11 Q In your KBSC system.</p> <p>12 A And what's the question again?</p> <p>13 Q Whether there were expert rules in your KBSC</p> <p>14 system, other than in the Neptune program.</p> <p>15 A Let me go back and look at my exhibit here.</p> <p>16 Q I believe the KBSC system that you referred to</p> <p>17 earlier was on Exhibit 503, page 0199.</p> <p>18 A Okay. Okay. Say that question again. I'm</p> <p>19 sorry.</p> <p>20 Q Is there expert rules in any portion of your</p> <p>21 KBSC system, other than the Neptune program?</p> <p>22 A Yes, sir.</p> <p>23 Q Where is the rules?</p> <p>24 A It's in one of the exhibits. It's in the</p> <p>25 program.</p>

22 (Pages 82 to 85)

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<p>1 Q Which exhibit are you referring to?</p> <p>2 A It's not here. It's in the source code.</p> <p>3 Q Other than the source code, which we will get</p> <p>4 to probably after lunch, is there any expert rules in</p> <p>5 any block depicted on page 0199 of Exhibit 503, other</p> <p>6 than the Neptune program?</p> <p>7 A Yes, sir.</p> <p>8 Q Where are these expert rules?</p> <p>9 A The expert rules could be in the parser.</p> <p>10 Q When you say "could be," do you mean they were</p> <p>11 part of your invention in the parser?</p> <p>12 A That's correct.</p> <p>13 Q Okay. Anywhere else?</p> <p>14 A Again, I have to take a look at the program</p> <p>15 that I wrote to be more -- to be certain that I did</p> <p>16 not leave out any of the modules.</p> <p>17 Q What program did you write?</p> <p>18 A I wrote a program that was written in C that</p> <p>19 has the knowledge-based rules.</p> <p>20 Q Do you know the name of the program?</p> <p>21 A I don't remember what I called it.</p> <p>22 Q Did you produce the source code that you're</p> <p>23 referring to?</p> <p>24 A Yes, sir.</p> <p>25 Q I have some source code in a document titled</p>	<p>1 A What's the question again? What were you</p> <p>2 looking for?</p> <p>3 Q The question is, what expert rules appear in</p> <p>4 the KBSC system of Exhibit 503, page 0199, other than</p> <p>5 the parser and the module selector?</p> <p>6 (Exhibit Nos. 512 through 518 were identified</p> <p>7 for the record).</p> <p>8 MR. OLIVER: Just for the record, Exhibit 512</p> <p>9 bears production numbers FOO 000264 through 268.</p> <p>10 Exhibit 513 bears production numbers FOO 0269</p> <p>11 through 0307. Exhibit 514 bears production numbers</p> <p>12 FOO 000308 through 3010. Exhibit 515 bears</p> <p>13 production number FOO 000311. Exhibit 516 bears</p> <p>14 production numbers FOO 000312 through 319.</p> <p>15 Exhibit 517 bears production numbers FOO</p> <p>16 000320 through 0322. Exhibit 518 bears production</p> <p>17 numbers FOO 000323 through 0407.</p> <p>18 THE WITNESS: Can you repeat the question?</p> <p>19 BY MR. OLIVER:</p> <p>20 Q What expert rules appear in your KBSC system</p> <p>21 of Exhibit 503, other than in the parser block and the</p> <p>22 module selection block?</p> <p>23 A To the best of my knowledge, those are the</p> <p>24 only -- those are the modules that I work with.</p> <p>25 Q When you say "that you work with," meaning --</p>
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<p>1 "A Knowledge-Based VLSI Module Selector With a</p> <p>2 Built-in Database Management System." Would that help</p> <p>3 refresh your recollection?</p> <p>4 A That's correct.</p> <p>5 Q (Tendering document). Handing you what has</p> <p>6 been marked as Exhibit 511, bearing a production</p> <p>7 numbers FOO 000157 through 0183. Would you just take</p> <p>8 a moment to look at that and let me know when you're</p> <p>9 finished.</p> <p>10 A (Witness complies).</p> <p>11 (Exhibit No. 511 was identified for the</p> <p>12 record).</p> <p>13 A Could you repeat that question?</p> <p>14 BY MR. OLIVER:</p> <p>15 Q Other than the parser and the Neptune program,</p> <p>16 are there any other expert rules in your</p> <p>17 knowledge-based silicon compiler of figure -- or of</p> <p>18 page 0199, Exhibit 503?</p> <p>19 A This Exhibit 511 is only the Neptune. There</p> <p>20 is still another source code.</p> <p>21 Q (Tendering document). I've handed you a</p> <p>22 series of Exhibits 512, 513, 514, 515, 516, 517 and</p> <p>23 518. They're all source code. If you would take a</p> <p>24 while to look at that and let me know when you're</p> <p>25 finished.</p>	<p>1 A I completed.</p> <p>2 Q When you say "completed," meaning you --</p> <p>3 A Got the program -- that's exactly right.</p> <p>4 Q When you sketched the drawing in Exhibit 503,</p> <p>5 were the parser and module selection modules</p> <p>6 completed?</p> <p>7 A To the best of my knowledge, they were in the</p> <p>8 process.</p> <p>9 Q Do you know why you sketched the system on</p> <p>10 this page?</p> <p>11 A The idea was to develop a knowledge-based</p> <p>12 silicon compiler.</p> <p>13 Q But you were already working on the module</p> <p>14 selection and the parser at the time you sketched this</p> <p>15 drawing; is that correct?</p> <p>16 A That's correct, sir.</p> <p>17 Q Were you already working on the module</p> <p>18 selection module at the time you created figure 1 of</p> <p>19 Exhibit 502?</p> <p>20 A Say that question again, please.</p> <p>21 Q Were you already working on a module selection</p> <p>22 block at the time that you created figure 1 of Exhibit</p> <p>23 502?</p> <p>24 A I was in the process, sir.</p> <p>25 Q When did you start creating the module</p>

23 (Pages 86 to 89)

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<p>1 selection block?</p> <p>2 A The idea of the module selection probably came</p> <p>3 from my master's thesis.</p> <p>4 Q Did it exist prior to your master's thesis?</p> <p>5 A No, sir.</p> <p>6 Q Do you know how long in time it took to create</p> <p>7 the idea for the module selection after your thesis?</p> <p>8 A Say that question again, please.</p> <p>9 Q Do you know how long it took before you</p> <p>10 created the module selection idea after your master's</p> <p>11 thesis was completed?</p> <p>12 A I still don't understand that question, sir.</p> <p>13 Q How long was it between the time you completed</p> <p>14 your master's thesis and the time you created the</p> <p>15 module selection block?</p> <p>16 A When you say "completed" --?</p> <p>17 Q When I say created, I don't mean completed, I</p> <p>18 mean came up with the idea.</p> <p>19 A I would say my master's thesis identified a</p> <p>20 need for a cell selection module.</p> <p>21 Q When did you propose a solution that met that</p> <p>22 need?</p> <p>23 A Could you clarify the question again.</p> <p>24 Q How long in time was it before you created</p> <p>25 something that would accomplish or meet that need that</p>	<p>1 A And the papers.</p> <p>2 Q The papers being the papers coauthored with</p> <p>3 Dr. Kobayashi?</p> <p>4 A That's correct, sir.</p> <p>5 Q Do you know when you began writing code for</p> <p>6 the module selector?</p> <p>7 A To the best of my recollection, the code for</p> <p>8 the module selector was initiated in late 1984.</p> <p>9 Q Did you conceive of the idea of a</p> <p>10 knowledge-based silicon compiler after your -- you</p> <p>11 conceived the idea of a module selector?</p> <p>12 A I don't recall the order of the -- you know,</p> <p>13 which comes first; is it top down or bottom up; I just</p> <p>14 don't recall.</p> <p>15 Q You did indicate earlier, however, that the</p> <p>16 sketch of Exhibit 503 was drawn after the module</p> <p>17 selection program was in progress; isn't that your</p> <p>18 testimony?</p> <p>19 A That's correct, sir.</p> <p>20 Q You said earlier that the master's thesis</p> <p>21 identified a need for the module selector; right?</p> <p>22 A I do not recall.</p> <p>23 Q It is what you said. Do you believe that to</p> <p>24 be accurate? If you want I could go back and actually</p> <p>25 read verbatim what you said. I asked you:</p>
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<p>1 was identified in your master's thesis?</p> <p>2 A Sorry. I still don't quite understand your</p> <p>3 question.</p> <p>4 Q Do you know when you first conceived of the</p> <p>5 idea for a module selector?</p> <p>6 A My estimate would be late 1984.</p> <p>7 Q How can you be sure?</p> <p>8 A At that time I was completing my master's</p> <p>9 thesis, and one of the things I learned or found out</p> <p>10 that there is a need for module selection.</p> <p>11 Q Did you document your idea for a module</p> <p>12 selection?</p> <p>13 A I do not recall.</p> <p>14 Q Do you have today anything that describes your</p> <p>15 original work regarding the module selection?</p> <p>16 A The only --</p> <p>17 MR. SU: Objection as to form.</p> <p>18 A The only evidence I have are produced here,</p> <p>19 sir.</p> <p>20 BY MR. OLIVER:</p> <p>21 Q When you say "produced here," are you pointing</p> <p>22 to a particular exhibit before you?</p> <p>23 A Exhibit 503, Exhibit 502 and possibly other</p> <p>24 exhibits, including the source code and --</p> <p>25 Q I'm sorry.</p>	<p>1 Do you know when you first conceived of the</p> <p>2 idea for a module selector? You answered: My</p> <p>3 estimate would be late 1984. I asked: How can you be</p> <p>4 sure? You said: At that time I was completing my</p> <p>5 master's thesis, and one of the things I learned or</p> <p>6 found out that there is a need for module selection.</p> <p>7 A That's true.</p> <p>8 Q Was there anything that you were doing that</p> <p>9 identified a need for a knowledge-based silicon</p> <p>10 compiler?</p> <p>11 A Say that question again.</p> <p>12 Q Is there anything that you were doing, similar</p> <p>13 to the master's thesis for your module selection, that</p> <p>14 identified a need for a knowledge-based silicone</p> <p>15 compiler?</p> <p>16 A Yes.</p> <p>17 Q What was that?</p> <p>18 A The need to capture expertise knowledge.</p> <p>19 Q For module selection the need was identified</p> <p>20 in your master's thesis.</p> <p>21 A To the best of my recollection, yes.</p> <p>22 Q What identified the need for the</p> <p>23 knowledge-based silicon compiler?</p> <p>24 A The need for capturing the knowledge of an</p> <p>25 expert designer.</p>

24 (Pages 90 to 93)

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Page 94	<p>1 Q What identified for you the need to capture</p> <p>2 the knowledge of an expert designer?</p> <p>3 A I don't understand your question. Could you</p> <p>4 say that again.</p> <p>5 Q For example, when you conceived of the idea</p> <p>6 for a module selector, you said, the need for such a</p> <p>7 module selector was identified in your thesis.</p> <p>8 Similarly, there must have been something like your</p> <p>9 thesis or something else, some other external</p> <p>10 information that you received that identified the need</p> <p>11 for the knowledge-based silicon compiler. Can you</p> <p>12 identify that source?</p> <p>13 A The --</p> <p>14 MR. SU: Objection as to form.</p> <p>15 A The inspiration for this knowledge-based</p> <p>16 silicon compiler came from the courses that I took</p> <p>17 with Professor Bonnell.</p> <p>18 BY MR. OLIVER:</p> <p>19 Q Is there anything else that was an inspiration</p> <p>20 for the knowledge-based silicon compiler?</p> <p>21 A Not that I know of.</p> <p>22 Q Was Dr. Kobayashi an inspiration for the</p> <p>23 knowledge-based --</p> <p>24 A I don't recall.</p> <p>25 Q Do you doubt that Dr. Kobayashi was the source</p>	Page 96	<p>1 (Lunch recess).</p> <p>2 BY MR. OLIVER:</p> <p>3 Q Back on the record. Referring back to the</p> <p>4 handwritten drawings of Exhibits 502 through 506.</p> <p>5 A Okay.</p> <p>6 Q Did Dr. Kobayashi provide any contribution</p> <p>7 whatsoever to any of the pages within Exhibits 502</p> <p>8 through 506?</p> <p>9 A Yes.</p> <p>10 Q What was his contribution?</p> <p>11 A His contribution is editorial.</p> <p>12 Q Can you provide us with an example of what</p> <p>13 edits he may have made?</p> <p>14 A For example, how the -- the blocks are</p> <p>15 arranged.</p> <p>16 Q Are you referring to Exhibit 502?</p> <p>17 A That's correct. Referring to figure 1 of</p> <p>18 Exhibit 502, which is on page 00192.</p> <p>19 Q What was his contribution?</p> <p>20 A Was in the arrangements of blocks.</p> <p>21 Q Cosmetically or technically?</p> <p>22 A Cosmetically.</p> <p>23 Q Anything else?</p> <p>24 A Not that I know of.</p> <p>25 Q Dr. Kobayashi, according to your testimony,</p>
Page 95	<p>1 of inspiration for the knowledge-based silicon</p> <p>2 compiler?</p> <p>3 A Say that question again.</p> <p>4 Q Do you doubt that Dr. Kobayashi was the</p> <p>5 inspiration for the knowledge-based silicon compiler</p> <p>6 that you created?</p> <p>7 A Dr. Kobayashi was not an inspiration.</p> <p>8 Q There is no question?</p> <p>9 A There is no question.</p> <p>10 Q You know Dr. Kobayashi and Dr. Bonnell worked</p> <p>11 together; right?</p> <p>12 A They were in the same department.</p> <p>13 Q They worked together; isn't that correct?</p> <p>14 A I don't recall.</p> <p>15 Q They collaborated on papers; right?</p> <p>16 A It is possible.</p> <p>17 Q You have no idea?</p> <p>18 A I don't recall.</p> <p>19 Q Isn't it possible that the inspiration</p> <p>20 provided by Dr. Bonnell was actually indirectly</p> <p>21 provided by Dr. Kobayashi?</p> <p>22 A I don't recall.</p> <p>23 MR. SU: Objection as to form.</p> <p>24 MR. OLIVER: Would you like to take a break</p> <p>25 for lunch?</p>	Page 97	<p>1 was not the source of any ideas conveyed in your</p> <p>2 Exhibits 502 through 506; is that correct?</p> <p>3 A I don't recall.</p> <p>4 Q Is it possible that he provided you with any</p> <p>5 of the ideas described in 502 through 506?</p> <p>6 A To the best of my knowledge, this is my</p> <p>7 original work, and his contribution was editorial.</p> <p>8 Q You indicated that after your master's thesis</p> <p>9 you were writing or headed towards a dissertation on</p> <p>10 cell selection; is that correct?</p> <p>11 A That's correct.</p> <p>12 Q Why didn't you attempt to write a dissertation</p> <p>13 on your knowledge-based silicon compiler?</p> <p>14 A Because at that time I think the biggest need</p> <p>15 is a cell selection.</p> <p>16 Q Wasn't the cell selection that you developed</p> <p>17 part of the KBSC system?</p> <p>18 A It was meant to be, that's correct.</p> <p>19 Q How could there be a need for the cell</p> <p>20 selection if there was no KBSC system to begin with?</p> <p>21 A The -- according to the best of my knowledge,</p> <p>22 the KBSC and the cell selection have a lot of things</p> <p>23 in common, which is the knowledge base.</p> <p>24 Q The knowledge base was part of your master's</p> <p>25 thesis; is that correct?</p>

25 (Pages 94 to 97)

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Page 98	<p>1 A That's incorrect.</p> <p>2 Q Why didn't you write a dissertation on the</p> <p>3 knowledge base?</p> <p>4 A The knowledge base alone would not be</p> <p>5 sufficient.</p> <p>6 Q Why is that?</p> <p>7 A You got to have something to -- you may have a</p> <p>8 theory. You've got to have some application to prove</p> <p>9 your theory.</p> <p>10 Q Wouldn't application of the knowledge base to</p> <p>11 VLSI design be sufficient?</p> <p>12 MR. SU: Objection to form.</p> <p>13 A The VLSI design is pretty general. You have</p> <p>14 to be a little bit more specific.</p> <p>15 BY MR. OLIVER:</p> <p>16 Q How is the cell selector applied to VLSI</p> <p>17 design?</p> <p>18 A The cell selection is part of the VLSI</p> <p>19 process.</p> <p>20 Q Wouldn't the knowledge base be part of that</p> <p>21 same process?</p> <p>22 A The knowledge base is just one avenue to</p> <p>23 accomplish that cell selection.</p> <p>24 Q Are you saying that your topic of cell</p> <p>25 selection was not utilizing a knowledge base?</p>	Page 100	<p>1 task of the VLSI design process.</p> <p>2 Q Having a knowledge base to select cells,</p> <p>3 wouldn't that be a narrow task?</p> <p>4 A Yes.</p> <p>5 Q Why didn't you do a dissertation on having a</p> <p>6 knowledge base to select cells?</p> <p>7 A Yes. As a matter of fact, that was my</p> <p>8 original goal was to have a knowledge-based, you know,</p> <p>9 system for cell selection.</p> <p>10 Q Did you have any evidence that that was your</p> <p>11 original dissertation?</p> <p>12 A I don't have, other than the papers that I</p> <p>13 wrote.</p> <p>14 Q What papers did you write?</p> <p>15 A Exhibit 510, Exhibit 509, Exhibit 508 and my</p> <p>16 handwritten notes.</p> <p>17 Q Do any of these exhibits, which include</p> <p>18 Exhibits 502 through 506 for the handwritten notes,</p> <p>19 and publications 508 through 510, mention your</p> <p>20 potential dissertation?</p> <p>21 A The word "dissertation" is not on the notes.</p> <p>22 Q Did you tell anyone, other than Dr. Kobayashi,</p> <p>23 that it was your intent to have a dissertation</p> <p>24 involving cell selection?</p> <p>25 A I do not recall.</p>
Page 99	<p>1 A Say that again.</p> <p>2 Q That your topic of cell selection was not</p> <p>3 utilizing a knowledge base?</p> <p>4 A The topic of cell selection?</p> <p>5 Q For your dissertation?</p> <p>6 A That's incorrect. That's not true.</p> <p>7 Q You indicated earlier that the topic of VLSI</p> <p>8 design was too broad for you to sufficiently craft a</p> <p>9 dissertation topic based on a knowledge base; isn't</p> <p>10 that correct?</p> <p>11 A That's not correct. That's not what I said.</p> <p>12 Q What did you say?</p> <p>13 A I said the topic of just VLSI design using</p> <p>14 knowledge-based systems is too broad of a title of a</p> <p>15 topic to begin with.</p> <p>16 Q Why, when nobody had done it before?</p> <p>17 A According to my -- to the best of my</p> <p>18 knowledge, to have a Ph.D. dissertation, you have to</p> <p>19 be very specific. It has to be non -- it cannot be of</p> <p>20 a broad nature.</p> <p>21 Q Well how is having a cell selection in VLSI</p> <p>22 design narrower?</p> <p>23 A That would be a specific task.</p> <p>24 Q Why? What's the difference?</p> <p>25 A Because you're talking about a very specific</p>	Page 101	<p>1 Q Exhibit 510 was not published; is that</p> <p>2 correct?</p> <p>3 A That's correct.</p> <p>4 Q Why wasn't it published?</p> <p>5 A We, Dr. Kobayashi and I, we were in the</p> <p>6 process of submitting this manuscript for publication</p> <p>7 when we parted ways.</p> <p>8 Q What year was Exhibit 510 created?</p> <p>9 A To the best of my recollection, this is --</p> <p>10 manuscript is written in -- initially in '85, '86, and</p> <p>11 it became a polished form in early '87.</p> <p>12 Q What contribution, if any, did Dr. Kobayashi</p> <p>13 make to Exhibit 510?</p> <p>14 A Editorial.</p> <p>15 Q Would you turn to page 254 of Exhibit 510.</p> <p>16 A (Examining document). Okay.</p> <p>17 Q What are the terms "74193" at the top?</p> <p>18 A Say that again. What's your question?</p> <p>19 Q The term "74193," or the number "74193" is</p> <p>20 represented at the top as an instant selected. Do you</p> <p>21 see that?</p> <p>22 A Okay.</p> <p>23 Q What is represented by that number?</p> <p>24 A That is a cell.</p> <p>25 Q What is that cell?</p>

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Page 102	<p>1 A It's an integrated circuit.</p> <p>2 Q Is it an integrated circuit produced by Texas</p> <p>3 Instruments?</p> <p>4 A Possibly.</p> <p>5 Q You don't know?</p> <p>6 A That number, 741 series is typically is a</p> <p>7 digital component.</p> <p>8 Q What is represented by the number 74173 in the</p> <p>9 next block down?</p> <p>10 A Say that again.</p> <p>11 Q What is represented by the number 74173 in the</p> <p>12 next block down on page 254?</p> <p>13 A It is a different component. It's a different</p> <p>14 IC component.</p> <p>15 Q When you say "IC," you mean chip?</p> <p>16 A That's correct.</p> <p>17 Q Integrated circuit?</p> <p>18 A That's correct.</p> <p>19 Q What is represented by the collection of these</p> <p>20 instances which appear as figure 4 on page 254?</p> <p>21 A This would be a list of integrated circuit</p> <p>22 blocks that have been selected by my program, Neptune,</p> <p>23 to implement a particular function.</p> <p>24 Q The output of Neptune would therefore be an</p> <p>25 identification of these 74 series integrated circuit</p>	Page 104	<p>1 in Florida State University?</p> <p>2 A No, sir.</p> <p>3 Q How would the revision date maintain the</p> <p>4 oldest revision from some other computer?</p> <p>5 A Whenever you rename -- copy files, you</p> <p>6 download files from one computer to another, depending</p> <p>7 on the system, they will automatically change the date</p> <p>8 on your file -- on your electronic file.</p> <p>9 Q Was the revision date -- strike that. Are you</p> <p>10 saying that whenever you copy the file from one</p> <p>11 computer onto another, the revision date would change?</p> <p>12 A Possibly, yes.</p> <p>13 Q Did that revision date change for Exhibits 513</p> <p>14 through 518?</p> <p>15 A Possibly.</p> <p>16 Q You don't know for sure?</p> <p>17 A I don't know for sure.</p> <p>18 MR. SU: Just for the record, Exhibit 518</p> <p>19 contains pages that don't look like code to me. So</p> <p>20 I just want to make sure the record is clear as to</p> <p>21 whether the witness is saying that all of this came</p> <p>22 from the printout or not.</p> <p>23 BY MR. OLIVER:</p> <p>24 Q Would you please take a look at Exhibit 518.</p> <p>25 A Okay.</p>
Page 103	<p>1 parts?</p> <p>2 A That's correct, sir.</p> <p>3 Q Would the output of figure 4 on that page be</p> <p>4 representative of the type of output of Neptune at the</p> <p>5 time that you and Dr. Kobayashi parted ways?</p> <p>6 A Say that again.</p> <p>7 Q Would the output of figure 4 be representative</p> <p>8 of the type of output of your program Neptune at the</p> <p>9 time that you and Dr. Kobayashi parted ways?</p> <p>10 A That's correct.</p> <p>11 Q The source code, which I believe we've labeled</p> <p>12 Exhibits 513 through 518, were produced by printing</p> <p>13 out files from your computer at the Florida State</p> <p>14 University; is that correct?</p> <p>15 A That's correct, sir.</p> <p>16 Q Do you know the revision date on your computer</p> <p>17 for these files, Exhibits 513 through 518?</p> <p>18 A I do not recall what the revision date is.</p> <p>19 Q Would the revision date be the date in which</p> <p>20 you loaded them on your computer?</p> <p>21 A No.</p> <p>22 Q What date would they be?</p> <p>23 A The revision date would be the date that I</p> <p>24 make changes to the program.</p> <p>25 Q Did you create those programs on your computer</p>	Page 105	<p>1 Q Did all of the pages making up Exhibit 518</p> <p>2 come from your computer at Florida State University?</p> <p>3 A No, sir.</p> <p>4 Q Are you able to identify the portions of</p> <p>5 Exhibit 518 that came from your computer at Florida</p> <p>6 State University?</p> <p>7 A No, sir.</p> <p>8 Q Did any pages of Exhibit 518 come from your</p> <p>9 computer?</p> <p>10 A Say that again.</p> <p>11 Q Did any pages of Exhibit 518 come from your</p> <p>12 computer?</p> <p>13 A When you say "come from my computer," where?</p> <p>14 Q At Florida State University.</p> <p>15 A You mean what's created; do you mean it was</p> <p>16 created --</p> <p>17 Q Produced by printing out from your computer</p> <p>18 the way in which Exhibits 513 through 517 were</p> <p>19 produced.</p> <p>20 A Okay. These pages were printed out at Florida</p> <p>21 State University, that's correct.</p> <p>22 Q When you say "these pages," which pages?</p> <p>23 A Pages on Exhibit 518, pages 000323 through</p> <p>24 00338.</p> <p>25 Q Any other pages?</p>

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<p>1 A Not in this Exhibit 518.</p> <p>2 Q Where did the remaining pages of Exhibit 518,</p> <p>3 which are pages 0339 through 0407, come from?</p> <p>4 A Say that again.</p> <p>5 Q Where did the remaining pages of Exhibit 518,</p> <p>6 which are pages 0339 through 0407, come from?</p> <p>7 A Say that again. I'm sorry.</p> <p>8 Q Pages 0339 through 0407.</p> <p>9 A Okay.</p> <p>10 Q Exhibit 518, where did those pages come from?</p> <p>11 A These pages, part of them came from my</p> <p>12 master's thesis defense slides, and part of it came</p> <p>13 from my own personal notes.</p> <p>14 Q Handing you what has been previously marked as</p> <p>15 Exhibit 39. Would you take a moment to review Exhibit</p> <p>16 39 and let me know when you've finished?</p> <p>17 A (Witness complies). Okay.</p> <p>18 Q Do you recognize Exhibit 39?</p> <p>19 A Yes, sir.</p> <p>20 Q When did you first see Exhibit 39?</p> <p>21 A I first came across this document, which was</p> <p>22 e-mailed to me by one of the attorneys at Shapiro,</p> <p>23 Weinstein.</p> <p>24 Q Do you remember the date?</p> <p>25 A I do not know the exact date, but I -- to the</p>	<p>1 that he was awarded a patent?</p> <p>2 A At that time I was his Ph.D. student, and I</p> <p>3 did not want to risk not being able to graduate.</p> <p>4 Q Subsequently you changed advisors, and you</p> <p>5 were no longer his student. Were you then</p> <p>6 disappointed in him for trying to commercialize his</p> <p>7 product?</p> <p>8 A I am not aware of any -- anything that</p> <p>9 transpired after I switch advisors.</p> <p>10 Q But you knew all along that he was continuing</p> <p>11 to work on the KBSC system; right?</p> <p>12 A I don't recall.</p> <p>13 Q Would you turn to column 16 of Exhibit 39.</p> <p>14 A Column 16.</p> <p>15 Q By the way, do you have any patents in your</p> <p>16 own name?</p> <p>17 A Excuse me?</p> <p>18 Q Do you have any patents in your own name?</p> <p>19 A No, sir.</p> <p>20 Q Did you ever apply for any patents?</p> <p>21 A No, sir.</p> <p>22 Q Why is that?</p> <p>23 A I guess I don't have the knowledge to apply</p> <p>24 for a patent.</p> <p>25 Q Column 16.</p>
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<p>1 best of my recollection, I believe it's in 2002.</p> <p>2 Q Did you review it at that time?</p> <p>3 A Yes, sir.</p> <p>4 Q Did you have a subsequent conversation with</p> <p>5 Mr. Weinstein?</p> <p>6 A Yes, sir.</p> <p>7 Q Do you recall what you discussed?</p> <p>8 A I told him that I was very disappointed.</p> <p>9 Q Why were you disappointed?</p> <p>10 A Because when I look at his patent, I realize</p> <p>11 that my former advisor had not -- had purposely left</p> <p>12 out my name on this patent.</p> <p>13 Q You weren't disappointed, however, when you</p> <p>14 were working for him at ICC, and he was working on the</p> <p>15 very same system that was patented; right?</p> <p>16 A That's correct.</p> <p>17 Q Why weren't you disappointed then?</p> <p>18 A I was not aware that he was going to seek a</p> <p>19 patent on this.</p> <p>20 Q But you were aware that he was commercializing</p> <p>21 it, the idea; right?</p> <p>22 A I was taking orders from him.</p> <p>23 Q Well why are you not disappointed when he was</p> <p>24 going to make money from selling the product that you</p> <p>25 invented, but yet you were disappointed when you see</p>	<p>1 A Okay.</p> <p>2 Q Have you reviewed claim 13, which appears</p> <p>3 around line 34 of column 16, particularly lines 34</p> <p>4 through 65?</p> <p>5 A (Examining document). Okay.</p> <p>6 Q My questions I will be referring to different</p> <p>7 claim elements. Do you understand the term "claim</p> <p>8 elements"?</p> <p>9 A I'm not sure.</p> <p>10 Q For our purposes there will be a reference to</p> <p>11 claim elements, and there are six different claim</p> <p>12 elements in claim 13. The claim elements are:</p> <p>13 Storing a set of definitions, which appears on line</p> <p>14 37; storing data describing a set of available</p> <p>15 integrated circuit hardware cells, which starts on</p> <p>16 line 39; storing in an expert system knowledge base,</p> <p>17 which appears at line 42; describing for a proposed</p> <p>18 application-specific integrated circuit, which appears</p> <p>19 at line 45; specifying for each described action and</p> <p>20 condition, which appears at line 48; and selecting</p> <p>21 from said stored data for each of those specified</p> <p>22 definitions, which begins at line 52.</p> <p>23 Do you see all those claim elements?</p> <p>24 A Yes, sir.</p> <p>25 Q Which one or more of these claim elements do</p>

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Page 110	<p>1 you believe you invented?</p> <p>2 A May I mark it?</p> <p>3 Q Yes, please do. Did you finish?</p> <p>4 A Yes.</p> <p>5 Q May I take a look?</p> <p>6 A (Tendering document).</p> <p>7 Q Just for the record, and please correct me if</p> <p>8 I'm wrong, you identified on Exhibit 39 in response to</p> <p>9 my question, the elements starting on line 39 of</p> <p>10 column 16: Storing data describing a set of</p> <p>11 integrated hardware cells; the element starting at</p> <p>12 line 42, storing in an expert system knowledge base,</p> <p>13 and the element starting at line 52, selecting from</p> <p>14 said stored data; is that correct?</p> <p>15 A That's correct, sir.</p> <p>16 Q Are there any other elements of claim 13 that</p> <p>17 you believe you invented?</p> <p>18 A I don't recall.</p> <p>19 Q Would you take a moment to look at all of the</p> <p>20 claims of this patent, which are claims one to 20, and</p> <p>21 let me know if there are any other elements that you</p> <p>22 believe you invented?</p> <p>23 A May I mark on it?</p> <p>24 Q Yes, please.</p> <p>25 A (Examining document). Okay. It's completed.</p>	Page 112	<p>1 that I picked, the ones crossed out I crossed out.</p> <p>2 Q (Examining document). I will read into the</p> <p>3 record, and you can confirm it.</p> <p>4 A Okay.</p> <p>5 Q You indicated for claim one, which starts on</p> <p>6 column 14, line 32, you indicated the element, a cell</p> <p>7 library, starting at line 47?</p> <p>8 A That's correct, sir.</p> <p>9 Q And at line 50, the cell selection means; is</p> <p>10 that correct?</p> <p>11 A That's correct.</p> <p>12 Q Did you not identify anything in claims two,</p> <p>13 three, four or five; is that correct?</p> <p>14 A To the best of my knowledge, that's correct,</p> <p>15 sir.</p> <p>16 Q In claim six, I assume you indicated the</p> <p>17 entire clause in claim six and claim seven; is that</p> <p>18 correct?</p> <p>19 A That's correct, sir.</p> <p>20 Q You did not indicate anything in claim eight.</p> <p>21 In claim nine you also identified the cell library,</p> <p>22 which begins approximately line 46 of column 15.</p> <p>23 A Yes, sir.</p> <p>24 Q And the cell selection meanings, which appears</p> <p>25 to start at line 48 of count 15; is that correct?</p>
Page 111	<p>1 Q Can I take a look?</p> <p>2 A Okay (tendering document).</p> <p>3 Q Starting with claim one, you have a mark at</p> <p>4 the beginning, which is known as the preamble. Is</p> <p>5 there an indication that you --</p> <p>6 A I guess I'm not clear if everything under</p> <p>7 claim one belongs to one, or do I need to separate</p> <p>8 them?</p> <p>9 Q Just for the purposes of our question, when I</p> <p>10 refer to "claim elements," it will be any type of --</p> <p>11 A Oh, okay.</p> <p>12 Q -- indention or paragraph that has this type</p> <p>13 of indention.</p> <p>14 A Okay. I see.</p> <p>15 Q For example, claim one at line 36 is one</p> <p>16 element, and line 39 is another element.</p> <p>17 A Okay.</p> <p>18 Q And the same fashion as we did for claim 15.</p> <p>19 A Okay. Let me correct that.</p> <p>20 Q That's the same for all the claims.</p> <p>21 A Okay. Maybe I use a different pen.</p> <p>22 Q This is your pen here.</p> <p>23 A Okay.</p> <p>24 Q May I take a look?</p> <p>25 A Yeah. The ones that I bubbled are the ones</p>	Page 113	<p>1 A That's correct.</p> <p>2 Q Column 16, you did not indicate anything for</p> <p>3 claim ten; is that correct?</p> <p>4 A That's correct.</p> <p>5 Q For claim 11 you indicated also the cell</p> <p>6 library, which appears to begin at line 18, and the</p> <p>7 knowledge base, which appears to begin at line 21; is</p> <p>8 that correct?</p> <p>9 A That's correct.</p> <p>10 Q You did not indicate anything for claim 12; is</p> <p>11 that correct?</p> <p>12 A That's correct.</p> <p>13 Q We discussed claim 13. Claims 14, 15, 16 and</p> <p>14 17 you did not indicate anything; is that correct?</p> <p>15 A Say that again.</p> <p>16 Q Claims 14, 15, 16 and 17 you did not indicate</p> <p>17 anything; is that correct?</p> <p>18 A To the best of my knowledge, that's correct.</p> <p>19 Q For claim 18 you identified the storing in a</p> <p>20 cell library element, which appears to begin at line</p> <p>21 16, and the storing in a knowledge base element, which</p> <p>22 begins to -- which appears to begin at page 19 -- line</p> <p>23 19; is that correct?</p> <p>24 A That's correct, sir.</p> <p>25 Q You did not indicate anything for claims 19</p>

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<p>1 and 20; is that correct?</p> <p>2 A That's correct, sir.</p> <p>3 Q Did you invent the claim elements that you</p> <p>4 identified in claim 13, which, again, are the storing</p> <p>5 data describing a set of available integrated circuit</p> <p>6 hardware cells beginning at line 39; the storing in an</p> <p>7 expert system knowledge base, which begins at line 42,</p> <p>8 and the selecting from said stored data, which begins</p> <p>9 at line 52 of column 16, all at the same time?</p> <p>10 MR. SU: Objection as to form.</p> <p>11 A I do not recall if it's all done at the same</p> <p>12 time.</p> <p>13 BY MR. OLIVER:</p> <p>14 Q Do you know when you invented the storing data</p> <p>15 describing a set of available integrated circuit</p> <p>16 hardware cells element, which begins at line 39?</p> <p>17 A To the best of my knowledge, it would be in</p> <p>18 1984 through '86.</p> <p>19 Q When you say "through," what do you mean?</p> <p>20 A The time period between 1984 and 1986.</p> <p>21 Q Did you invent them during that entire period,</p> <p>22 or did you mean that you invented them at some point</p> <p>23 between '84 through '86?</p> <p>24 A At some point between '84 and '86, sir.</p> <p>25 Q Do you know if you invented -- strike that.</p>	<p>1 three items under line item number 13 were --</p> <p>2 Q You mean claim 13?</p> <p>3 A Yeah, claim 13.</p> <p>4 Q Yes.</p> <p>5 A -- were invented during the period between</p> <p>6 1984 and 1986.</p> <p>7 Q At some point --</p> <p>8 A At some point, that's correct.</p> <p>9 Q -- between '84 and '86?</p> <p>10 A Yes. Although I cannot pinpoint a specific</p> <p>11 date.</p> <p>12 Q Do you have any evidence of this invention of</p> <p>13 any of the elements that you identified in claim 13,</p> <p>14 which are the ones that begin at lines 39, 42 and 52?</p> <p>15 A Yes, sir.</p> <p>16 Q What is your evidence?</p> <p>17 A The evidence is my hand notes and the computer</p> <p>18 programs and the papers that I wrote.</p> <p>19 Q Just to be clear for the record, the evidence</p> <p>20 of invention is the handwritten notes which we have</p> <p>21 marked as Exhibits 502 through 506?</p> <p>22 A That's correct.</p> <p>23 Q The computer programs identified as Exhibits</p> <p>24 511 through 518, and which publications?</p> <p>25 A The publications, Exhibit 508 and Exhibit 509.</p>
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<p>1 Is it possible that you invented the element that</p> <p>2 began at line 39 somewhere within 1986?</p> <p>3 A I do not recall, sir.</p> <p>4 Q Is it possible that you invented it towards</p> <p>5 the end of 1986?</p> <p>6 A I do not recall.</p> <p>7 Q Do you recall when you invented the element</p> <p>8 that begins at line 42 or the element that begins at</p> <p>9 line 52?</p> <p>10 A What's your question again?</p> <p>11 Q Whether you recall the date in which you</p> <p>12 invented either the element that begins at line 42 or</p> <p>13 the element that begins at line 52?</p> <p>14 A Say that question begin.</p> <p>15 Q Do you recall when you invented the element</p> <p>16 that begins at line 42?</p> <p>17 A To the best of my knowledge, those were</p> <p>18 invented during the period of between 1984 and 1986.</p> <p>19 Q Is that the same time period in which you</p> <p>20 invented the element of selecting from said stored</p> <p>21 data, which begins at line 52 of column 16?</p> <p>22 A Say that again.</p> <p>23 Q Did you invent the element that begins at line</p> <p>24 52 in the time period 1984 through 1986?</p> <p>25 A That's correct. Let me clarify this. The</p>	<p>1 Q Any other publications?</p> <p>2 A And Exhibit 510, the unpublished manuscript.</p> <p>3 Q Any other publications?</p> <p>4 A Exhibit 507.</p> <p>5 Q Any other publications?</p> <p>6 A To the best of my recollection, that was all.</p> <p>7 Q For all of the other elements you identified</p> <p>8 in claims one through 12, if any, and 14 through 20 of</p> <p>9 the 432 patent, which is Exhibit 39, is the evidence</p> <p>10 of your invention found in those same exhibits which</p> <p>11 are 502 through 506, 511 through 518, 507 through 510?</p> <p>12 A Say that question again, please.</p> <p>13 Q For all the other elements that you identified</p> <p>14 on Exhibit 39 for claims one through 12 and claims 14</p> <p>15 through 20, are you relying on the same evidence of</p> <p>16 invention as you did for claims -- for the claim</p> <p>17 elements of claim 13?</p> <p>18 A Say that again. Sorry.</p> <p>19 Q Are you relying for proof of your invention of</p> <p>20 the claim elements you identified in the 432 patent</p> <p>21 with respect to claims one through 12 and 14 through</p> <p>22 20, if any?</p> <p>23 A Are those the ones that I did not mark?</p> <p>24 Q You identified several elements on Exhibit 39</p> <p>25 within certain claims, one, six, seven, nine, 11 and</p>

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<p>1 18; is that correct?</p> <p>2 A Sorry. I still don't quite understand your</p> <p>3 question.</p> <p>4 Q As we confirmed, you had marked in Exhibit 39</p> <p>5 certain claim elements that you believe you invented</p> <p>6 with respect to claims one, six, seven, nine, 11 and</p> <p>7 18; is that correct?</p> <p>8 A I still don't understand that question.</p> <p>9 Q The question is simply, did you identify claim</p> <p>10 elements --</p> <p>11 A Could we do one at a time instead of, you</p> <p>12 know, a range of numbers?</p> <p>13 Q Well, sure. Did you identify elements in</p> <p>14 claim one?</p> <p>15 A Yes, sir.</p> <p>16 Q Did you identify elements in claim six?</p> <p>17 A Yes, sir.</p> <p>18 Q Did you identify elements in claim seven?</p> <p>19 A Yes, sir.</p> <p>20 Q Did you identify elements in claim nine?</p> <p>21 A Yes, sir.</p> <p>22 Q Did you identify elements in claim 11?</p> <p>23 A Yes, sir.</p> <p>24 Q Did you identify elements in claim 18?</p> <p>25 A Yes, sir.</p>	<p>1 that correct?</p> <p>2 A That's correct.</p> <p>3 Q You did not identify anything in claim 15; is</p> <p>4 that correct?</p> <p>5 A That's correct.</p> <p>6 Q You did not identify anything in claim 16; is</p> <p>7 that correct?</p> <p>8 A That's correct.</p> <p>9 Q You did not identify anything in claim 17; is</p> <p>10 that correct?</p> <p>11 A That's correct.</p> <p>12 Q You did not identify anything in claim 19; is</p> <p>13 that correct?</p> <p>14 A That's correct.</p> <p>15 Q You did not identify anything in claim 20; is</p> <p>16 that correct?</p> <p>17 A That's correct. And I would like to add that</p> <p>18 I did not identify them based on the best of my</p> <p>19 knowledge.</p> <p>20 Q For the claim elements that you did identify</p> <p>21 other than those in claim 13, are you relying on the</p> <p>22 evidence of invention that you've relied on for the</p> <p>23 claim elements of claim 13?</p> <p>24 A Say that again.</p> <p>25 Q For the elements that you identified in all</p>
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<p>1 Q Other than claim 13, you did not identify any</p> <p>2 other -- I'm sorry, strike that.</p> <p>3 Did you identify elements in any other claim</p> <p>4 that I did not -- strike that. You did not identify</p> <p>5 anything in claim two; is that correct?</p> <p>6 A That's correct.</p> <p>7 Q You did not identify anything in claim three;</p> <p>8 is that correct?</p> <p>9 A That's correct.</p> <p>10 Q You did not identify anything in claim four;</p> <p>11 is that correct?</p> <p>12 A That's correct.</p> <p>13 Q You did not identify anything in claim five;</p> <p>14 is that correct?</p> <p>15 A That's correct.</p> <p>16 Q You did not identify anything in claim eight;</p> <p>17 is that correct?</p> <p>18 A That's correct.</p> <p>19 Q You did not identify anything in claim ten; is</p> <p>20 that correct?</p> <p>21 A That's correct.</p> <p>22 Q You did not identify anything in claim 12; is</p> <p>23 that correct?</p> <p>24 A That's correct.</p> <p>25 Q You did not identify anything in claim 14; is</p>	<p>1 the claims, other than claim 13, are you relying on</p> <p>2 the same evidence of invention as you are relying on</p> <p>3 for the claim elements you identified in claim 13?</p> <p>4 A That's correct.</p> <p>5 Q Do you want to take a break?</p> <p>6 A Yeah, yeah.</p> <p>7 (Short recess).</p> <p>8 THE WITNESS: I would like to make two</p> <p>9 clarifications. One, the first clarification is</p> <p>10 that I was not aware of the pending patent in the</p> <p>11 works while I was working under Kobayashi, and I</p> <p>12 was not aware of the patent even after I quit</p> <p>13 working with Dr. Kobayashi.</p> <p>14 The second clarification is, during the break</p> <p>15 I was recollecting my thoughts, and I realized that</p> <p>16 I had done other contributions too besides the one</p> <p>17 that I specified that I mark on this document. And</p> <p>18 if I may, I would like to go back and look at my</p> <p>19 handwritten notes and identify them.</p> <p>20 BY MR. OLIVER:</p> <p>21 Q Of course. Just to be clear, you're going to</p> <p>22 identify them in the handwritten notes or in the</p> <p>23 patent?</p> <p>24 A Well I didn't find them in the patent.</p> <p>25 Q By looking at your notes; right?</p>

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<p>1 A That's correct.</p> <p>2 Q Please do so.</p> <p>3 A Thank you.</p> <p>4 Q While you're doing that, I want to mark as</p> <p>5 Exhibit 519 the marked-up copy of Exhibit 39, which is</p> <p>6 the 432 patent, just so there is a record of your</p> <p>7 annotations.</p> <p>8 (Exhibit No. 519 was identified for the</p> <p>9 record).</p> <p>10 THE WITNESS: You don't mind if I take a call?</p> <p>11 It could be an urgent call.</p> <p>12 MR. OLIVER: Sure.</p> <p>13 (Discussion off the record).</p> <p>14 A Mr. Oliver, I believe there are some more</p> <p>15 evidence that I have produced that were not shown</p> <p>16 here, other exhibits, I believe.</p> <p>17 BY MR. OLIVER:</p> <p>18 Q What --</p> <p>19 A Hand -- hand-sketched documents.</p> <p>20 Q Do you know what was on the hand-sketched</p> <p>21 diagram?</p> <p>22 A Let me see.</p> <p>23 Q I have something here which is some kind of a</p> <p>24 draft of an article that also has some attached --</p> <p>25 A That's correct. That's the one I was looking</p>	<p>1 A On the recollection, when I was answering your</p> <p>2 question earlier, I forgot that I have the additional</p> <p>3 notes that were just produced to me.</p> <p>4 Q Exhibit 520?</p> <p>5 A That's correct, sir.</p> <p>6 Q What in Exhibit 520 informed you that you also</p> <p>7 invented these other elements that you identified?</p> <p>8 A Exhibit 520, along with my handwritten notes</p> <p>9 from other exhibits, made me realize that I have done</p> <p>10 more than I put down earlier.</p> <p>11 Q So essentially you invented everything in this</p> <p>12 claim; is that correct?</p> <p>13 A I would not say everything.</p> <p>14 Q What did you not invent in claim one?</p> <p>15 A Say that again.</p> <p>16 Q Essentially you invented everything in claim</p> <p>17 one; isn't that correct?</p> <p>18 A That's correct, yes.</p> <p>19 Q Did you invent everything in claim 13?</p> <p>20 A That's correct.</p> <p>21 Q Although you didn't identify everything in</p> <p>22 claim 13?</p> <p>23 A Wait a minute. Wait a minute. I would like</p> <p>24 to make a correction right here. The first one I</p> <p>25 would like to make a claim on that, too, so</p>
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<p>1 for.</p> <p>2 Q I apologize. I didn't realize this was a</p> <p>3 hand-drawn attachment. I will mark that as Exhibit</p> <p>4 520.</p> <p>5 (Exhibit No. 520 was identified for the</p> <p>6 record).</p> <p>7 Q Exhibit 520 bears production numbers FOO 00184</p> <p>8 through 0188.</p> <p>9 A (Examining document). Okay. I'm finished,</p> <p>10 sir.</p> <p>11 Q May I take a look?</p> <p>12 A Yes (tendering document). The ones that I</p> <p>13 have bubbled and put a checkmark next to it or</p> <p>14 underneath it is the one that I have just added.</p> <p>15 Q For the record, it appears that you've</p> <p>16 identified all of the elements of claim one; is that</p> <p>17 correct?</p> <p>18 A May I see it? Say the question again.</p> <p>19 Q You now appear to have identified all the</p> <p>20 claim elements of claim one; is that correct?</p> <p>21 A That's correct, sir.</p> <p>22 Q That's quite a change from your earlier</p> <p>23 testimony; isn't it?</p> <p>24 A That's correct.</p> <p>25 Q Why did you make that change?</p>	<p>1 essentially will be all of --</p> <p>2 Q So you now claim to have invented everything</p> <p>3 in this claim 13?</p> <p>4 A That's correct, sir.</p> <p>5 Q And you never told anybody about your</p> <p>6 invention; is that right?</p> <p>7 A That's correct.</p> <p>8 Q You didn't tell anyone?</p> <p>9 A The only person who might know about it would</p> <p>10 be my advisor at that time.</p> <p>11 Q And how did you tell him?</p> <p>12 A I gave him the example figure 1 of Exhibit</p> <p>13 542.</p> <p>14 Q You gave that to him?</p> <p>15 A That's correct, sir.</p> <p>16 Q Did you give all of your sketches, which are</p> <p>17 Exhibits 502 through 506 and Exhibit 520?</p> <p>18 A I don't recall.</p> <p>19 Q Do you know for sure you gave Exhibit 502?</p> <p>20 A I know, to the best of my recollection, I gave</p> <p>21 figure 1 of Exhibit 502 to Dr. Kobayashi.</p> <p>22 Q Did you give the figure page 199 of Exhibit</p> <p>23 503 to Dr. Kobayashi?</p> <p>24 A I don't recall, but I do recall discussing a</p> <p>25 lot of my ideas with him.</p>

32 (Pages 122 to 125)

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<p>1 Q Do you recall discussing all of the elements 2 depicted in Exhibit 503? 3 A Very likely. 4 Q Likely or for certain? 5 A Very likely. I do not recall all the details. 6 Q What evidence do you have to show that you 7 actually discussed those elements with him? 8 A Say that question again. 9 Q What evidence do you have to show that you 10 actually discussed the elements of Exhibit 503 with 11 Dr. Kobayashi? 12 A The only thing I can think of is the revisions 13 to this sketch. 14 Q What revisions are you talking about? 15 A I'm talking about the scratches, for example, 16 on page 000199 on Exhibit 503. 17 Q Yes. 18 A You can see that I have scratched out some of 19 the -- for example, the control flow graph. 20 Q Yes. 21 A That typically comes from my discussions with 22 my advisor. 23 Q Is that his handwriting? 24 A No. No, sir. 25 Q Is that your handwriting?</p>	<p>1 within these Exhibits, 502 through 506, that you can 2 say with certainty that you showed Dr. Kobayashi? 3 A (Examining document). I would say Exhibit 4 503, page 000200; Exhibit 504, page 000204, and under 5 the same exhibit, page 000205, 206, 207, 208, 209, and 6 that's it. And Exhibit 506, page 000256, 257, 258 and 7 259 through 263, which is basically the entire 8 exhibit; Exhibit 502, page 000192, 193, 194, 196, 197 9 and 198; Exhibit 514, the entire exhibit of 514; 10 Exhibit 515. 11 Q The entire exhibit? 12 A That's right. That's only one page, 515. And 13 I believe that's all the exhibits. 14 Q All the other pages that you did not identify 15 you cannot be certain whether or not you disclosed 16 them to Dr. Kobayashi; is that correct? 17 A That's correct. 18 Q For the pages and exhibits that you did 19 identify, how can you be so certain that you did 20 disclose them to Dr. Kobayashi? 21 A I usually shared with him my ideas to get some 22 feedback. 23 Q How do you know for certain that the 24 individual pages that you identified were pages that 25 you showed to Dr. Kobayashi?</p>
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<p>1 A That's my handwriting. 2 Q Is that your hand scratching out of the 3 control flow graph? 4 A That's my handwriting. That's right. 5 Q Why is the control flow graph scratched out on 6 Exhibit 503? 7 A It was just based on my idea at that time. 8 Q How does that relate to your conversation with 9 Dr. Kobayashi? 10 A Again, I do not recall the exact conversation. 11 Q And you're not certain whether or not you 12 actually disclosed Exhibit 503 to Dr. Kobayashi; is 13 that correct? 14 A Say that again. 15 Q You're not certain that you actually disclosed 16 Exhibit 503 to Dr. Kobayashi; is that correct? 17 A It is highly probable that I have shown him 18 and discussed with him. 19 Q You cannot be positively certain, however; is 20 that correct? 21 A That's correct. 22 Q You can be certain, however, that you showed 23 him Exhibit 502, page 0192; is that correct? 24 A To the best of my knowledge, yes. 25 Q Are there any other hand drawings or pages</p>	<p>1 A Based on the papers that were published. 2 Q Why is that? 3 A The reason is, some of the papers that were 4 published have some schematics and ideas that came 5 from the notes. 6 Q When you say you showed Dr. Kobayashi these 7 hand drawing pages that you identified, were they 8 first showed to Dr. Kobayashi in a draft of some 9 papers? 10 A I do not recall. 11 Q Is there any other reason why you can be so 12 certain that you showed Dr. Kobayashi any of your 13 pages or papers that you identified? 14 A It's based on the corrections on the 15 handwritten notes. 16 Q And those corrections were your own 17 corrections; is that correct? 18 A That's correct, sir. 19 Q You would not have made those corrections 20 without discussing it with Dr. Kobayashi; is that your 21 testimony? 22 A Say that again. 23 Q You would not have made those corrections 24 without talking to Dr. Kobayashi; is that your 25 testimony?</p>

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<p>1 A That's not true.</p> <p>2 Q You could have made those corrections without</p> <p>3 Dr. Kobayashi's input; is that correct?</p> <p>4 A Possibly.</p> <p>5 Q So the mere fact that there were corrections</p> <p>6 on those handwritten drawings does not mean that you</p> <p>7 showed those handwritten drawings to Dr. Kobayashi;</p> <p>8 isn't that right?</p> <p>9 A Say that again.</p> <p>10 Q The mere fact that there are corrections on</p> <p>11 those handwritten drawings does not mean that you</p> <p>12 showed those handwritten drawings to Dr. Kobayashi?</p> <p>13 A I believe that the ones that I told you I</p> <p>14 showed to him to get his feedback.</p> <p>15 Q And do you believe so based on the corrections</p> <p>16 that were made?</p> <p>17 A More than the corrections and also the papers</p> <p>18 that were published.</p> <p>19 Q Is there anything else that gives you that</p> <p>20 indication?</p> <p>21 A That would be all.</p> <p>22 Q Do you know when you showed them to</p> <p>23 Dr. Kobayashi?</p> <p>24 A Between the time frame of 1984 and '86.</p> <p>25 Q Is it possible that Dr. Kobayashi was</p>	<p>1 system, you became an expert, and you invented the</p> <p>2 rule-based VLSI design system; is that correct?</p> <p>3 A That's correct.</p> <p>4 Q And you never patented it; is that correct?</p> <p>5 A That's correct.</p> <p>6 Q You never documented it, other than hand</p> <p>7 sketches; is that correct?</p> <p>8 A That's correct.</p> <p>9 Q You never disclosed it to anyone other than</p> <p>10 Dr. Kobayashi?</p> <p>11 A That's correct.</p> <p>12 Q Before the time you started working for</p> <p>13 Howrey, you never mentioned it; is that correct?</p> <p>14 A Say that again.</p> <p>15 Q Up until the time you started working for</p> <p>16 Howrey in 2006, you never mentioned your invention to</p> <p>17 anyone; is that correct?</p> <p>18 A I still don't understand that question.</p> <p>19 Q It's only now that you're being paid by Howrey</p> <p>20 as a consultant that you are telling people that you</p> <p>21 invented the KBSC system; isn't that correct?</p> <p>22 MR. SU: Objection, argumentative.</p> <p>23 A I don't recall.</p> <p>24 BY MR. OLIVER:</p> <p>25 Q You testified that you didn't keep a lab</p>
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<p>1 simultaneously working on the work that was ultimately</p> <p>2 patented in Exhibit 519?</p> <p>3 A Say that again.</p> <p>4 Q Is it possible that Dr. Kobayashi was</p> <p>5 independently, but yet simultaneously, working on a</p> <p>6 knowledge-based system at the same time that you were</p> <p>7 working on a knowledge-based system?</p> <p>8 A You mean him working by himself?</p> <p>9 Q Yes.</p> <p>10 A Not possible.</p> <p>11 Q Why is that?</p> <p>12 A The reason is, VLSI is not his background.</p> <p>13 Q Was VLSI your background?</p> <p>14 A That was my background.</p> <p>15 Q Were you an expert at the time?</p> <p>16 MR. SU: Objection to form.</p> <p>17 A I considered myself an expert in VLSI.</p> <p>18 BY MR. OLIVER:</p> <p>19 Q How many years of experience did you have in</p> <p>20 VLSI at the time?</p> <p>21 A I first learned of the subject matter, to the</p> <p>22 best of my recollection, would be in late 1983 or</p> <p>23 early 1984.</p> <p>24 Q So in less than one year, which is the time</p> <p>25 frame in which you say you may have invented the KBSC</p>	<p>1 notebook; is that correct?</p> <p>2 A Could you clarify what a lab notebook --</p> <p>3 Q I believe I asked you that before, and you</p> <p>4 said you did not.</p> <p>5 A That's correct.</p> <p>6 Q You didn't keep a journal; is that correct?</p> <p>7 A What do you mean by "journal"?</p> <p>8 Q A diary?</p> <p>9 A No, sir.</p> <p>10 Q Did you have any other inventions besides the</p> <p>11 KBSC system?</p> <p>12 MR. SU: Objection as to form.</p> <p>13 A I don't recall, sir.</p> <p>14 BY MR. OLIVER:</p> <p>15 Q During the period 1984 through 1986 when you</p> <p>16 invented the KBSC system, did you utilize University</p> <p>17 of South Carolina resources?</p> <p>18 A Could you explain what these resources are?</p> <p>19 Q Did you do the work at the university?</p> <p>20 A Would you elaborate some more what</p> <p>21 resources --</p> <p>22 Q When you conceived your KBSC system, did you</p> <p>23 do so utilizing any resources or materials or</p> <p>24 facilities of the University of South Carolina?</p> <p>25 A Yes, I did.</p>

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<p>1 Q What did you utilize?</p> <p>2 A The computers.</p> <p>3 Q Anything else?</p> <p>4 A Possibly the paper.</p> <p>5 Q You never reduced to practice this KBSC</p> <p>6 system; isn't that correct?</p> <p>7 MR. SU: Objection as to form.</p> <p>8 A Would you explain what you mean?</p> <p>9 BY MR. OLIVER:</p> <p>10 Q You never created a working prototype of the</p> <p>11 KBSC system; isn't that correct?</p> <p>12 A Could you explain what you mean by "working</p> <p>13 prototype."</p> <p>14 Q You've never heard of the term "working</p> <p>15 prototype"?</p> <p>16 A Okay. Working to what extent?</p> <p>17 Q What is your definition of "prototype"?</p> <p>18 A Prototype means it works to some extent but</p> <p>19 still may have bugs in it.</p> <p>20 Q Using that definition, did you ever create a</p> <p>21 prototype of the KBSC system that you invented?</p> <p>22 A Not entire KBSC.</p> <p>23 Q Any part of the KBSC system?</p> <p>24 A Yes, I do.</p> <p>25 Q What part?</p>	<p>1 A I don't have any documents right now.</p> <p>2 Q So just so the record is clear, you only</p> <p>3 produced source code for the parser, the cell selector</p> <p>4 and the frame-based database; is that correct?</p> <p>5 A That's correct.</p> <p>6 Q When you conceived of the KBSC system, did you</p> <p>7 do so utilizing any resources from ICC?</p> <p>8 A To the best of my knowledge, no.</p> <p>9 Q Were you working for ICC at the time that you</p> <p>10 conceived of the KBSC system?</p> <p>11 A No, sir.</p> <p>12 Q Did anyone at ICC direct you to invent the</p> <p>13 KBSC system?</p> <p>14 A No, sir.</p> <p>15 Q Do you believe that Dr. Kobayashi left you off</p> <p>16 of the 432 patent, which is now Exhibit 519,</p> <p>17 intentionally?</p> <p>18 A Yes, I do.</p> <p>19 Q What was his motive?</p> <p>20 A To the best of my knowledge, I believe he was</p> <p>21 very bitter that I, you know, left him.</p> <p>22 Q So bitter that he filed a patent without your</p> <p>23 knowledge?</p> <p>24 A Possibly.</p> <p>25 Q So bitter that he created an entire</p>
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<p>1 A The -- I believe it's the parser and the cell</p> <p>2 selector.</p> <p>3 Q You never created the entire system; is that</p> <p>4 correct?</p> <p>5 A I --</p> <p>6 MR. SU: Objection as to form.</p> <p>7 A I don't recall.</p> <p>8 BY MR. OLIVER:</p> <p>9 Q You have no evidence of creating a prototype;</p> <p>10 isn't that correct?</p> <p>11 MR. SU: Objection as to form.</p> <p>12 A I do not recall, sir.</p> <p>13 BY MR. OLIVER:</p> <p>14 Q You produced in this litigation source code</p> <p>15 for the selector model -- module, but not for the</p> <p>16 entire KBSC system; isn't that correct?</p> <p>17 A I produced a code for parts of the KBSC.</p> <p>18 Q What parts?</p> <p>19 A The parser, the module selector.</p> <p>20 Q Anything else?</p> <p>21 A And the frames database system.</p> <p>22 Q Anything else?</p> <p>23 A There may be others that I do not recall at</p> <p>24 this time.</p> <p>25 Q That you produced?</p>	<p>1 corporation based on your system; right?</p> <p>2 A That's not correct.</p> <p>3 Q Oh, the corporation wasn't based on your</p> <p>4 system?</p> <p>5 A No. I say he did not create the corporation</p> <p>6 just because I left him.</p> <p>7 Q The corporation existed before you left him;</p> <p>8 right?</p> <p>9 A That's correct.</p> <p>10 Q He was already attempting to commercialize a</p> <p>11 KBSC system; isn't that correct?</p> <p>12 A Say that again.</p> <p>13 Q Dr. Kobayashi was already trying to</p> <p>14 commercialize a KBSC system before you left him;</p> <p>15 right?</p> <p>16 A Say that again.</p> <p>17 Q When you began working for him in 1986, he was</p> <p>18 already working on a KBSC system; wasn't that correct?</p> <p>19 MR. SU: Objection as to form.</p> <p>20 A I did not start working for him in '86.</p> <p>21 BY MR. OLIVER:</p> <p>22 Q Oh, when did you start working for him, for</p> <p>23 ICC? Step back. When I say "working for him," I</p> <p>24 meant working for him as an employee or consultant to</p> <p>25 ICC.</p>

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Page 138	<p>1 A Okay. Okay.</p> <p>2 Q So my question is, when you started working</p> <p>3 for ICC under Dr. Kobayashi in 1986, Dr. Kobayashi was</p> <p>4 already trying to commercialize a KBSC system; isn't</p> <p>5 that correct?</p> <p>6 A I'm not aware of.</p> <p>7 Q You were working on the module selector; isn't</p> <p>8 that right?</p> <p>9 A I was working on -- that's correct.</p> <p>10 Q Module selector was used for the KBSC system;</p> <p>11 isn't that correct?</p> <p>12 A That's correct.</p> <p>13 Q Was it used for any other system?</p> <p>14 A Possible.</p> <p>15 Q Do you know of any other application for the</p> <p>16 cell selector?</p> <p>17 A Possible.</p> <p>18 Q Could it be used for any non-rule-based</p> <p>19 system?</p> <p>20 A Possible.</p> <p>21 Q So the cell selector is not critical to the</p> <p>22 KBSC system; is that correct?</p> <p>23 A That's not correct.</p> <p>24 MR. SU: Objection as to form.</p> <p>25 BY MR. OLIVER:</p>	Page 140	<p>1 Dr. Kobayashi left you off of the 432 patent?</p> <p>2 A Say that question again.</p> <p>3 Q Is there any other reason, other than the fact</p> <p>4 that he was bitter for you having left him, for</p> <p>5 Dr. Kobayashi to leave you off of the 432 patent?</p> <p>6 A Say that again.</p> <p>7 Q Is there any other reason, other than the fact</p> <p>8 that Dr. Kobayashi was bitter for you having left him,</p> <p>9 that Dr. Kobayashi would have intentionally left you</p> <p>10 off of the 432 patent?</p> <p>11 A I do not know.</p> <p>12 Q Do you have any evidence that Dr. Kobayashi</p> <p>13 intentionally left you off the patent?</p> <p>14 A I do not know.</p> <p>15 Q You have no written documentation that</p> <p>16 Dr. Kobayashi intentionally left you off the patent;</p> <p>17 isn't that correct?</p> <p>18 A That's correct.</p> <p>19 Q You have no real basis for stating that</p> <p>20 Dr. Kobayashi intentionally left you off the patent;</p> <p>21 isn't that correct?</p> <p>22 A Say that again.</p> <p>23 Q You have no real indication that Dr. Kobayashi</p> <p>24 intentionally left you off the patent; isn't that</p> <p>25 correct?</p>
Page 139	<p>1 Q Who did you work with at ICC?</p> <p>2 A Can you clarify, what do you mean by "who do</p> <p>3 you work with"?</p> <p>4 Q Names of people you worked with while at ICC.</p> <p>5 A Toro (phonetic) Ozeki and a few others that I</p> <p>6 have, you know, I've forgotten the names.</p> <p>7 Q Do you know what Mr. Ozeki was doing?</p> <p>8 A Yes.</p> <p>9 Q What was he doing?</p> <p>10 A His role was routing and placement.</p> <p>11 Q Routing and placement of what?</p> <p>12 A Of cells, modules.</p> <p>13 Q For a KBSC system?</p> <p>14 A That's correct.</p> <p>15 Q Your KBSC system?</p> <p>16 A Uh-huh.</p> <p>17 Q Do you know what the others were working on?</p> <p>18 A I do not recollect what the other students are</p> <p>19 working on.</p> <p>20 Q Did anyone ever go to you for advice as to how</p> <p>21 to build a prototype for the KBSC system?</p> <p>22 MR. SU: Objection as to form.</p> <p>23 A I do not recall, sir.</p> <p>24 BY MR. OLIVER:</p> <p>25 Q Is there any other reason why you believe</p>	Page 141	<p>1 MR. SU: Objection as to form.</p> <p>2 A I do not know the answer to that question.</p> <p>3 BY MR. OLIVER:</p> <p>4 Q And you don't know whether or not you have any</p> <p>5 proof that he intentionally left you off the patent?</p> <p>6 A I do not know of any proof.</p> <p>7 Q You don't have any proof; isn't that correct?</p> <p>8 A That's correct.</p> <p>9 Q Isn't it possible that he truly believed that</p> <p>10 this work was his own work and the work of his joint</p> <p>11 inventor?</p> <p>12 A Say that again.</p> <p>13 Q Isn't it possible that Dr. Kobayashi truly</p> <p>14 believed that the work that was patented was the work</p> <p>15 of his own and his co-inventor?</p> <p>16 A Could you rephrase that?</p> <p>17 MR. SU: Objection as to form.</p> <p>18 BY MR. OLIVER:</p> <p>19 Q Isn't it possible that Kobayashi believed that</p> <p>20 he was the true inventor, along with his co-inventor,</p> <p>21 on the 432 patent?</p> <p>22 A I do not know the answer to that.</p> <p>23 MR. SU: Objection as to form.</p> <p>24 BY MR. OLIVER:</p> <p>25 Q Handing you what has been previously marked as</p>

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Page 142	<p>1 Kobayashi Exhibit No. 4, would you -- I'm sorry, 2 bearing production numbers KBSC 0001 through 0028. 3 Would you take a moment to review that document and 4 let me know when you've finished. 5 A Okay (examining document). Okay. 6 Q Do you recognize Exhibit 4? 7 A Could you explain, what do you mean by 8 "recognize"? 9 Q Have you seen it before? 10 A No, sir. 11 Q This is an agreement bearing the date January 12 15, 1987. Were you working at ICC at the time? 13 A Say that again. 14 Q Were you working at ICC at the time of January 15 15, 1987? 16 A It is possible. 17 Q Would you please turn to appendix A, which 18 starts on page 0009 of Exhibit 4. 19 A Okay. 20 Q Do you recognize any of the elements listed as 21 one through nine on that page? 22 A Yes. 23 Q Did you invent any of the elements shown on 24 that page? 25 A Yes.</p>	Page 144	<p>1 named Neptune. 2 A Uh-huh. 3 Q Does the cell selector on page 024 and the 4 Neptune program, 025, reflect your invention? 5 A Say that again. 6 Q Did you invent the cell selector on page 024 7 and the Neptune program of 025? 8 A Yes, sir. 9 Q Is the Neptune used for cell selection? 10 A Yes, sir. 11 Q Why is Stuart Anderson listed on page 025 as 12 the designer with you of Neptune? 13 A I do not know, sir. 14 Q You don't know? 15 A I don't know. 16 Q Isn't it possible that the Neptune program 17 that is listed in this document is not your Neptune 18 program? 19 A That's not possible. 20 Q Why is that? 21 A I'm the person who wrote that program. 22 Q Isn't it possible that Stuart Anderson revised 23 the program to make it marketable? 24 A I do not know the answer to that. 25 Q Other than the name "Neptune," you have no</p>
Page 143	<p>1 Q What elements did you invent? 2 A I believe, to the best of my knowledge, would 3 be the AAF translator, the cell selector and the 4 netless generator, and possibly elements of the 5 controller equation generator and the cell generator. 6 Q When you made that clarification after the 7 break, did you do so because your attorney advised you 8 to make that clarification? 9 A No, sir. 10 Q Did you make it on your own volition? 11 A Say that again. 12 Q Did you make it on your own? 13 A Yes, sir. 14 Q Did you write the Neptune program yourself? 15 A That's correct, sir. 16 Q Did anyone help you? 17 A No, sir. 18 Q Who is Stuart Anderson? 19 A I don't quite remember him. 20 Q Would you turn to pages 024 and 025 of Exhibit 21 4? 22 A Okay. 23 Q 024 has the title "Cell Selector." 24 A Uh-huh. 25 Q At the top of page 025 there is a program</p>	Page 145	<p>1 idea whether or not the program was ever used in any 2 product of ICC; isn't that correct? 3 A Say that again. 4 Q Other than the name "Neptune," shown on this 5 page, you have no idea whether or not the program that 6 you know to be Neptune was ever used? 7 A I do not know that. 8 Q In fact you have no idea whether any of the 9 work that you did ultimately was reduced to practice 10 into a working prototype; isn't that right? 11 A I do not know. 12 Q You don't know whether or not the 432 patent 13 was based on a working prototype that was made long 14 after you had left Dr. Kobayashi; isn't that right? 15 MR. SU: Objection as to form. 16 A I do not know the answer to that. 17 BY MR. OLIVER: 18 Q Is it your testimony that the Neptune program 19 was completed as of January 15, 1987? 20 A Say that again. 21 Q Is it your testimony that the Neptune program 22 was already completed by 1987, January 15, 1987? 23 A Could you clarify by what you mean by 24 "completed"? Completed totally bug free or 25 completed --?</p>

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<p>1 Q Was it operable?</p> <p>2 A Definitely it was operable.</p> <p>3 Q Did it perform cell selection?</p> <p>4 A Yes.</p> <p>5 Q And at the time you did it independently;</p> <p>6 isn't that correct?</p> <p>7 A Say that again.</p> <p>8 Q At the time you created the Neptune program</p> <p>9 independently; isn't that correct?</p> <p>10 A That's correct.</p> <p>11 Q Would you turn to page 028 of Exhibit 4.</p> <p>12 There is a row towards the bottom that says "cell</p> <p>13 selector"; do you see that?</p> <p>14 A Yes, I do.</p> <p>15 Q Did you write the specification for the cell</p> <p>16 selector?</p> <p>17 MR. SU: Objection as to form.</p> <p>18 A I do not recall.</p> <p>19 BY MR. OLIVER:</p> <p>20 Q In fact, this page indicates that the cell</p> <p>21 selector specification had not yet been fixed and</p> <p>22 would be fixed two months from the schedule listed;</p> <p>23 isn't that correct?</p> <p>24 MR. SU: Objection as to form.</p> <p>25 A I do not recall.</p>	<p>1 A According to page 180 -- I'm sorry -- page 916</p> <p>2 of this Exhibit 508, to the best of my knowledge there</p> <p>3 is no reference to any knowledge-based system.</p> <p>4 Q The bottom of page 914, the last paragraph, it</p> <p>5 starts with the phrase, heuristic rules. Do you see</p> <p>6 that? What do you mean by heuristic rules?</p> <p>7 A Heuristic rules are rule of thumbs.</p> <p>8 Q Are heuristic rules synonymous with expert</p> <p>9 rules?</p> <p>10 A Possibly.</p> <p>11 Q Did you intend the term "heuristic rules" to</p> <p>12 refer to expert rules?</p> <p>13 A Say that again.</p> <p>14 Q In your article on page 914, when you use the</p> <p>15 term "heuristic rules," did you intend to mean "expert</p> <p>16 rules"?</p> <p>17 A Possibly.</p> <p>18 Q You can't tell for certain?</p> <p>19 A It's quite possible.</p> <p>20 Q Is it quite possible that you did not mean the</p> <p>21 term to be expert rules?</p> <p>22 A Say that again.</p> <p>23 Q You said it was possible, but isn't it also</p> <p>24 possible that the term heuristic rules does not refer</p> <p>25 to expert rules?</p>
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<p>1 BY MR. OLIVER:</p> <p>2 Q According to this table, the development of</p> <p>3 the cell selector wouldn't be finished for another six</p> <p>4 months; isn't that correct?</p> <p>5 A I do not recall, sir.</p> <p>6 Q And in fact the cell selector would not be</p> <p>7 debugged, finished and document writing finished until</p> <p>8 eight months later; is that correct?</p> <p>9 A I do not recall.</p> <p>10 MR. SU: Objection as to form.</p> <p>11 BY MR. OLIVER:</p> <p>12 Q Do you have any doubt that this timetable is</p> <p>13 accurate?</p> <p>14 MR. SU: Objection as to form.</p> <p>15 A I do not recall, sir.</p> <p>16 BY MR. OLIVER:</p> <p>17 Q Would you turn back to Exhibit 508? This is</p> <p>18 the knowledge-based system article.</p> <p>19 A Okay.</p> <p>20 Q You don't make reference to a knowledge-based</p> <p>21 selecting compiler in this article; do you?</p> <p>22 A Say that again.</p> <p>23 Q You do not make any reference to a</p> <p>24 knowledge-based silicon compiler in this article;</p> <p>25 isn't that correct?</p>	<p>1 A Like I mentioned earlier, the heuristic rules</p> <p>2 are rule of thumbs that experts have relied on.</p> <p>3 Q Experts rely on heuristic rules, but do</p> <p>4 heuristic rules embody expert design knowledge?</p> <p>5 A That's one way.</p> <p>6 Q One way?</p> <p>7 A Uh-huh.</p> <p>8 Q In this article, can you point to any expert</p> <p>9 rules?</p> <p>10 A On page 000914 of Exhibit 508, and in the</p> <p>11 middle of the page there are three -- I'm sorry, four</p> <p>12 lines, starting with "if," then statements, those are</p> <p>13 the rules.</p> <p>14 Q Are there any expert rules disclosed in</p> <p>15 Exhibit 508?</p> <p>16 A Any other rules?</p> <p>17 Q Yes.</p> <p>18 A Besides the one I just pointed out?</p> <p>19 Q Yes.</p> <p>20 A (Examining document). Yes.</p> <p>21 Q What rules are --</p> <p>22 A That would be on page 915 of Exhibit 508, in</p> <p>23 the bottom of the first column, starting with item</p> <p>24 number six, repeat for each instance in W, and then</p> <p>25 you have the else if statements.</p>

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Page 150	<p>1 Q Are these expert rules?</p> <p>2 A To the best of my knowledge, yes.</p> <p>3 Q Any other rules in this document?</p> <p>4 A In item number three, the same page, if</p> <p>5 subfunction has a list of logic components, then</p> <p>6 append to list S and notified user, or else announce</p> <p>7 failure.</p> <p>8 Q Any other rules?</p> <p>9 A Item number seven and item number nine. That</p> <p>10 would be all.</p> <p>11 Q There is a reference to a CMUDA system on page</p> <p>12 914 in the introduction paragraph. Do you see that?</p> <p>13 A Yes, sir.</p> <p>14 Q Do you recall the CMUDA system?</p> <p>15 A Yes.</p> <p>16 Q How does that system differ from your KBSC</p> <p>17 system?</p> <p>18 A I do not recall the details. It's been a long</p> <p>19 time.</p> <p>20 Q You wouldn't make reference to it unless you</p> <p>21 thought there was a difference; isn't that correct?</p> <p>22 A That's correct, sir.</p> <p>23 Q You would not publish a paper citing it or</p> <p>24 even publish the paper at all if you believed that the</p> <p>25 work was not unique; isn't that correct?</p>	Page 152	<p>1 Q You didn't speak to him after you had a</p> <p>2 conversation with Michael Weinstein of my office?</p> <p>3 A Oh, absolutely no. It was way before Michael</p> <p>4 Weinstein called me.</p> <p>5 Q Did you speak with anyone after you spoke with</p> <p>6 Michael Weinstein?</p> <p>7 A Did I speak with anybody?</p> <p>8 Q In connection with this litigation or</p> <p>9 Dr. Kobayashi's work?</p> <p>10 A No, I did not discuss it with anybody.</p> <p>11 Q Other than the place in routing, what else did</p> <p>12 Dr. -- I mean did Mr. Ozeki do in terms of working on</p> <p>13 the KBSC system for ICC?</p> <p>14 A I do not know, sir.</p> <p>15 Q Do you believe there are any others who were</p> <p>16 left off of the inventorship of the 432 patent besides</p> <p>17 yourself?</p> <p>18 A I do not know --</p> <p>19 Q Should Mr. Ozeki have been an inventor?</p> <p>20 A I do not know the answer to that question,</p> <p>21 sir.</p> <p>22 Q Handing you what has been marked Exhibit 521,</p> <p>23 bearing production numbers FOO 000189 through 0191.</p> <p>24 This is a document entitled "Project Description for</p> <p>25 ECE 890B," spring 1986. Would you take a moment to</p>
Page 151	<p>1 A That's correct.</p> <p>2 Q Is there any doubt that you believe there was</p> <p>3 a difference between your KBSC system and the CMUDA</p> <p>4 system that was cited in your paper?</p> <p>5 A Say that again.</p> <p>6 Q Is there any doubt that you thought there was</p> <p>7 a difference between the KBSC system and the CMUDA</p> <p>8 system?</p> <p>9 A I do not recall.</p> <p>10 Q Shall we take a break?</p> <p>11 THE WITNESS: Sure.</p> <p>12 (Short recess).</p> <p>13 BY MR. OLIVER:</p> <p>14 Q Okay. Back on the record. When is the last</p> <p>15 time you spoke to Mr. Ozeki?</p> <p>16 A When you say spoke with --</p> <p>17 Q For any reason.</p> <p>18 A Are you talking about through the phone or in</p> <p>19 person?</p> <p>20 Q Either.</p> <p>21 A I believe, to the best of my recollection, the</p> <p>22 last time I spoke with Mr. Tour row Ozeki was back in</p> <p>23 1993.</p> <p>24 Q Why did you speak to him?</p> <p>25 A I do not recall, sir.</p>	Page 153	<p>1 look at that and let me know when you've finished.</p> <p>2 A (Witness complies). Okay. I'm ready.</p> <p>3 (Exhibit No. 521 was identified for the</p> <p>4 record).</p> <p>5 BY MR. OLIVER:</p> <p>6 Q Do you recognize Exhibit 521?</p> <p>7 A Yes, sir.</p> <p>8 Q What is it?</p> <p>9 A This is a project description proposal that</p> <p>10 was submitted for this class in the spring 1986.</p> <p>11 Q What class is this?</p> <p>12 A The name, the title of the class is -- I'm</p> <p>13 sorry, number of the class is ECE 890B.</p> <p>14 Q Who was the instructor of that class?</p> <p>15 A I don't recall, sir.</p> <p>16 Q Are these your ideas depicted in Exhibit 521?</p> <p>17 A That's correct, sir.</p> <p>18 Q Where did you get these ideas?</p> <p>19 A Based on the courses that I've taken prior to</p> <p>20 this course.</p> <p>21 Q Did Dr. Kobayashi provide you with any of</p> <p>22 these ideas?</p> <p>23 A I do not recall, sir.</p> <p>24 Q You recited a document or paper authored by</p> <p>25 Dr. Kobayashi; isn't that right?</p>

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Page 154	Page 156
<p>1 A That's correct.</p> <p>2 Q In fact it's authored by Kobayashi and</p> <p>3 Takefuji; right?</p> <p>4 A That's correct.</p> <p>5 Q Why did you cite that?</p> <p>6 A There was a paper that talks about the SDF.</p> <p>7 Q What is the SDF?</p> <p>8 A The state description form.</p> <p>9 Q And what's the SDF used for?</p> <p>10 A Basically the SDF is an intermediate form for</p> <p>11 describing state transitions.</p> <p>12 Q What is it used for?</p> <p>13 A It can be used to describe finite state</p> <p>14 machines.</p> <p>15 Q Anything else?</p> <p>16 A Not that I know of.</p> <p>17 Q You didn't invent the concept of silicon</p> <p>18 compilation; did you?</p> <p>19 A No.</p> <p>20 Q But you invented a knowledge-based silicon</p> <p>21 compilation; isn't that right?</p> <p>22 A To the best of my knowledge, yes.</p> <p>23 Q Is this a self-study course, ECE 890B?</p> <p>24 A I do not recall, sir.</p> <p>25 Q Dr. Kobayashi was the instructor; isn't that</p>	<p>1 yours reflected in Exhibit 522?</p> <p>2 A Yes, sir.</p> <p>3 Q Which ideas?</p> <p>4 A The idea of knowledge-based approach to VLSI</p> <p>5 CAD.</p> <p>6 Q Do you believe that is your idea, not</p> <p>7 Dr. Kobayashi's, of a knowledge-based system for</p> <p>8 translating high-level specifications to VLSI systems</p> <p>9 based on designer's expert knowledge?</p> <p>10 A That's correct, sir.</p> <p>11 Q Do you believe it's your ideas and not</p> <p>12 Dr. Kobayashi's of a mapping a set of macro operations</p> <p>13 to functional modules?</p> <p>14 A Say that again.</p> <p>15 Q Do you believe it is your idea, not</p> <p>16 Dr. Kobayashi's, to map a set of macro operations to</p> <p>17 functional modules?</p> <p>18 A That's correct.</p> <p>19 Q Did the mapping of functional modules use your</p> <p>20 Neptune program?</p> <p>21 A Say that again.</p> <p>22 Q Did the mapping of macro operations to</p> <p>23 functional modules utilize your Neptune program?</p> <p>24 A Are you referring to this article?</p> <p>25 Q Yes, the mapping that's discussed in this</p>
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<p>1 right?</p> <p>2 A I'm not sure. I do not recall.</p> <p>3 Q Do you have any reason to doubt Dr. Kobayashi</p> <p>4 was the instructor?</p> <p>5 A Could be, but, again, I don't have any</p> <p>6 recollection.</p> <p>7 Q Handing you what has been marked as Exhibit</p> <p>8 522. This is a document bearing production numbers</p> <p>9 KBSC 0094 through 1005. Would you take a moment to</p> <p>10 review this exhibit and let me know when you finish.</p> <p>11 A (Examining document). Okay.</p> <p>12 (Exhibit No. 522 was identified for the</p> <p>13 record).</p> <p>14 BY MR. OLIVER:</p> <p>15 Q Do you recognize Exhibit 522?</p> <p>16 A I do not recall, sir.</p> <p>17 Q Is this not the article presented at a</p> <p>18 Greenville, South Carolina --</p> <p>19 A It could be.</p> <p>20 Q -- trade show that you discussed earlier</p> <p>21 today?</p> <p>22 A Possibly.</p> <p>23 Q It's the one you saw on the Internet; right?</p> <p>24 A Possibly.</p> <p>25 Q Do you believe that there are any ideas of</p>	<p>1 article.</p> <p>2 A Okay.</p> <p>3 Q Did this mapping that you claim to be your</p> <p>4 idea utilize your Neptune program?</p> <p>5 A The -- say that again.</p> <p>6 Q Does Exhibit 522 describe the concept of</p> <p>7 mapping a set of macro operations to functional</p> <p>8 modules, utilizing your Neptune program?</p> <p>9 A My Neptune program is a cell selection -- what</p> <p>10 are you talking "mapping"?</p> <p>11 Q Is there a difference between "mapping" and</p> <p>12 "cell selection"?</p> <p>13 A Oh, yes.</p> <p>14 Q What's the difference?</p> <p>15 A Cell selection is one thing, and mapping,</p> <p>16 you're talking about one-to-one. Cell selection, it</p> <p>17 could be more than one possibility.</p> <p>18 Q Do you believe that when Dr. Kobayashi</p> <p>19 describes mapping here, he does not describe cell</p> <p>20 selection?</p> <p>21 A Are you referring to the abstract?</p> <p>22 Q I'm referring to the introductory paragraph on</p> <p>23 page 997, second paragraph.</p> <p>24 A And what's your question again?</p> <p>25 Q Do you believe that the use of the term</p>

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Page 158	<p>1 "mapping" in the second sentence of the second</p> <p>2 paragraph on page 997 refers to something other than</p> <p>3 cell selection?</p> <p>4 A Say that one more time.</p> <p>5 Q Do you believe that the term "mapping,"</p> <p>6 appearing on page 997 in the sentence, mapping a set</p> <p>7 of macro operations to functional modules refers to</p> <p>8 something other than cell selection?</p> <p>9 A Yes, sir.</p> <p>10 Q Nevertheless, do you believe you invented this</p> <p>11 concept of mapping as described in that sentence?</p> <p>12 A Yes, sir.</p> <p>13 Q Do you believe there is anything in this</p> <p>14 Exhibit 522 that you did not invent?</p> <p>15 A I did not invent the antecedent action form.</p> <p>16 Q Would you identify that by page and --</p> <p>17 A That is page 998 of Exhibit 522.</p> <p>18 Q You did not invent the AAF form itself; is</p> <p>19 that correct?</p> <p>20 A That's correct, sir.</p> <p>21 Q You invented the use of the AAF form in the</p> <p>22 knowledge-based system; isn't that correct?</p> <p>23 A That's exactly correct, sir.</p> <p>24 Q Do you believe the concepts described in</p> <p>25 Exhibit 522 to be the concepts patented in the 432</p>	Page 160	<p>1 and the programs that I have wrote.</p> <p>2 Q Any other reason?</p> <p>3 A Not at this point.</p> <p>4 Q At some other point will you have other</p> <p>5 reasons?</p> <p>6 A Could be, possibly.</p> <p>7 Q Do you have any documents that you have not</p> <p>8 produced that may refresh your recollection?</p> <p>9 A I do not.</p> <p>10 Q You made some clarifications already on the</p> <p>11 record. Are there any other changes to your testimony</p> <p>12 that you wish to make?</p> <p>13 A Not at this point.</p> <p>14 Q Are there any questions that you answered that</p> <p>15 you now believe you did not properly understand?</p> <p>16 A No, sir.</p> <p>17 Q You mentioned that you don't recall on a</p> <p>18 number of occasions. Do you at this time have any</p> <p>19 memory of anything that you at that time did not</p> <p>20 recall when I asked that question?</p> <p>21 A Could you say that question again.</p> <p>22 Q You answered "I don't recall" to several of my</p> <p>23 questions. Do you now, at this time, recall any</p> <p>24 answers to any of those questions?</p> <p>25 A No, sir.</p>
Page 159	<p>1 patent?</p> <p>2 A Say that again.</p> <p>3 Q Do you believe the concepts described in this</p> <p>4 Exhibit 522 to be the same concepts that were patented</p> <p>5 in the 432 patent?</p> <p>6 A That's correct, sir.</p> <p>7 Q Is that why you believe that you are inventor</p> <p>8 of the 432 patent?</p> <p>9 A Say that again.</p> <p>10 Q Is that where you believe you are the inventor</p> <p>11 of the 432 patent?</p> <p>12 A Why -- are you talking about what you just</p> <p>13 mentioned earlier?</p> <p>14 Q Do you believe that the ideas shown in this</p> <p>15 Exhibit 522 are your own?</p> <p>16 A That's correct, sir.</p> <p>17 Q Do you believe that these same ideas are the</p> <p>18 ideas in the 432 patent?</p> <p>19 A That's correct.</p> <p>20 Q Do you therefore believe that you are an</p> <p>21 inventor of the 432 patent because the ideas in this</p> <p>22 article, 522, are the same ideas in the 432 patent?</p> <p>23 A The reason I believe the ideas in the patent</p> <p>24 are mine is because of the documents that I have</p> <p>25 produced, my -- specifically the hand-sketched notes</p>	Page 161	<p>1 MR. OLIVER: I have no more questions at this</p> <p>2 time.</p> <p>3 MR. SU: Okay. I have no questions. We will</p> <p>4 read and sign.</p> <p>5 (The deposition was concluded at 4:30 p.m.</p> <p>6 Reading and signing is not waived).</p> <p>7</p> <p>8</p> <p>9</p> <p>10</p> <p>11</p> <p>12</p> <p>13</p> <p>14</p> <p>15</p> <p>16</p> <p>17</p> <p>18</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>

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## CERTIFICATE OF OATH

STATE OF FLORIDA     )  
COUNTY OF LEON     )

I, the undersigned authority, certify that said  
designated witness personally appeared before me and was  
duly sworn.

WITNESS my hand and official seal this     day  
of June, 2006.

SARAH B. GILROY

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## CERTIFICATE OF REPORTER

STATE OF FLORIDA     )  
COUNTY OF LEON     )

I, SARAH B. GILROY, Registered Professional Reporter,  
certify that the foregoing proceedings were taken before  
me at the time and place therein designated; that my  
shorthand notes were thereafter translated under my  
supervision; and the foregoing pages numbered 1 through  
162 are a true and correct record of the aforesaid  
proceedings.

I further certify that I am not a relative, employee,  
attorney or counsel of any parties, nor am I a relative  
or employee of any of the parties' attorney or counsel  
connected with the action, nor am I financially  
interested in the action.

DATED this     day of June, 2006.

SARAH B. GILROY, RPR, CRR  
Notary Public

My Commission Expires: 02-02-10  
My Commission Number: DD 075718

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